

***United States Court of Appeals
for the Second Circuit***



APPENDIX

74-1765

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United States Court of Appeals

FOR THE SECOND CIRCUIT

Appeal No. 74-1765

ESSO RESEARCH AND ENGINEERING COMPANY,

Plaintiff-Appellant,

v.

KAHN AND COMPANY, INC. and CHANDLER-EVANS, INC.,

Defendants-Appellees.

ON APPEAL FROM THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF CONNECTICUT

JOINT APPENDIX

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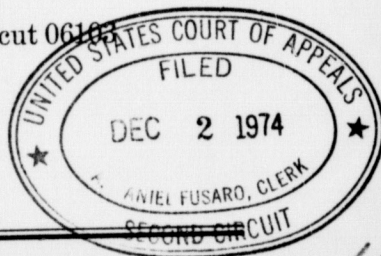
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Civil Action No. 12,140

DATE

PROCEEDINGS

1967

9/8 Complaint filed. Summons issued and together with copies of same and of complaint, handed to the Marshal for service.

10/31 Answer and Counterclaim, filed by Defendants.

11/22 Answer to Defendants' Counterclaim, filed by Plaintiff.

1973

3/20 Stipulation re claims of U.S. Patent No. 2,944,627, filed.

6/25 Hearing on Defendants' Motion to Re-Open for Additional Testimony Based Upon Such New Evidence. "The motion to reopen this case for the inclusion of additional testimony limited to the German decree in question and its content is granted. Hopefully the parties will be able to provide the court with an acceptable translation of that decree." Blumenfeld, J. M-6/27/73. Copies mailed.

8/6 Letter addressed to Judge Blumenfeld containing stipulation re the admission of certain evidence and requesting that the time for filing briefs be extended from August 8 to August 31, 1973, filed at Hartford.

Relevant Docket Entries

DATE

PROCEEDINGS

1974

- 4/30 Memorandum of Decision entered. The defendant is entitled to a judgment dismissing the complaint and declaring that U.S. Letters Patent No. 2,944,627 is invalid, and it is So Ordered. Blumenfeld, J. M-5/2/74. Copies mailed to all counsel by Hartford Office.
- 5/2 Judgment entered declaring U.S. Letters Patent No. 2,944,627 invalid and with costs to the defendants. Markowski, C. M-5/2/74. Copies mailed.
- 5/31 Notice of Appeal, filed by plaintiff. Copies mailed to Clerk, U.S.C.A. and to all counsel.

Complaint

IN THE
UNITED STATES DISTRICT COURT
DISTRICT OF CONNECTICUT

ESSO RESEARCH & ENGINEERING COMPANY,

Plaintiff,

v.

KAHN & COMPANY, INC. and CHANDLER-EVANS, INC.,

Defendants.

1. Plaintiff is a corporation incorporated under the laws of the State of Delaware having its principal place of business at 425 Park Avenue, Linden, New Jersey 07036.

2. On information and belief, defendant Kahn & Company, Inc., is a corporation incorporated under the laws of the State of Connecticut having a regular and established place of business at 885 Wells Road, Wethersfield, Connecticut 06101, within the District of Connecticut, where it has committed acts of infringement, contributory infringement and inducing infringement complained of hereinafter.

3. On information and belief, defendant Chandler-Evans, Inc., is a corporation incorporated under the laws of the State of Delaware having a regular and established place of business at Charter Oak Boulevard, West Hartford,

Complaint

Connecticut 06110, within the District of Connecticut, where it has committed acts of infringement complained of hereinafter.

4. This action arises under the Patent Laws of the United States and more particularly 35 U.S.C., Sections 271 and 281. Jurisdiction is conferred on this Court by 28 U.S.C., Section 1338(a). Venue is conferred on this Court by 28 U.S.C., Section 1400(b).

5. On July 12, 1960 United States Letters Patent No. 2,944,627 was duly and legally issued to plaintiff as assignee of Charles W. Skarstrom for Method And Apparatus For Fractionating Gaseous Mixtures By Adsorption.

6. On information and belief, defendant Kahn & Company, Inc., has actively induced infringement of said Patent No. 2,944,627 by defendant Chandler-Evans, Inc. and others and has itself infringed and contributorily infringed said Letters Patent in this judicial district and elsewhere in the United States, and said defendant Kahn & Company, Inc. will continue to do so unless enjoined by this Court. Defendant Kahn & Company, Inc. was notified of the issue of said Letters Patent No. 2,944,627 and of plaintiff's right thereunder.

7. On information and belief, defendant Chandler-Evans, Inc. has infringed Letters Patent No. 2,944,627 within this judicial district and said defendant will continue to do so unless enjoined by this Court.

Complaint

WHEREFORE, PLAINTIFF PRAYS for the issuance of judgment that:

(1) United States Letters Patent No. 2,944,627 is good and valid and that defendant Kahn & Company, Inc. infringed, induced infringement and contributorily infringed said patent and that defendant Chandler-Evans, Inc. infringed said patent.

(2) The defendants, and each of them, their officers, agents, employees, successors and assigns, respectively, and all holding by, through, or under them, or acting in their behalf, be preliminarily enjoined and restrained during the pendency of this action and preliminarily enjoined thereafter

(a) from infringing or contributing to the infringement of plaintiff's United States Letters Patent No. 2,944,627;

(b) from manufacturing, selling, offering for sale, or using or inducing the use of the method and apparatus described and claimed in plaintiff's United States Letters Patent No. 2,944,627.

(3) Accountings be ordered to determine the damages to which plaintiff is entitled by reason of said acts of infringements by defendant Kahn & Company, Inc. and defendant Chandler-Evans, Inc., respectively, of United States Letters Patent No. 2,944,627, and that such damages and plaintiff's costs and disbursements including attorneys' fees in this action be awarded to plaintiff.

Complaint

(4) Plaintiff be granted such other further relief as the equity of this case may require and as the Court may deem just and proper.

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Answer and Counterclaim

UNITED STATES DISTRICT COURT

DISTRICT OF CONNECTICUT

[CAPTION OMITTED]

Both defendants, answering the complaint:

1. Admit the allegations of paragraph 1.
2. Admit that Kahn & Company, Inc. is a Connecticut corporation having a regular and established place of business at 885 Wells Road, Wethersfield, Connecticut 06109, and deny every other allegation of paragraph 2.
3. Admit that Chandler-Evans, Inc. is a Delaware corporation having a regular and established place of business at Charter Oak Boulevard, West Hartford, Connecticut 06110, and deny every other allegation of paragraph 3.
4. Admit the allegations of paragraph 4.
5. Admit that U. S. Patent No. 2,944,627 issued to the plaintiff on July 12, 1960, but deny that it was duly and legally issued.
6. Deny the allegations of paragraph 6.
7. Deny the allegations of paragraph 7.

Answer and Counterclaim

SPECIAL AND AFFIRMATIVE DEFENSES

In further answer to the complaint, both defendants assert:

8. The plaintiff has unduly and inexcusably delayed in bringing this action and is estopped to assert infringement or any other act complained of herein by reason of its long delay and laches, from at least as early as January, 1959. During all of which time, especially from the date July 12, 1960, when the said patent issued, to the date of the complaint herein, the plaintiff had knowledge of the manufacture and sale by the defendant Kahn and the use by Kahn customers, such as the defendant Chandler-Evans, of the devices alleged to infringe. During such period of delay and laches, and especially in the forepart thereof, the defendant Kahn was lulled by and relied upon such inaction by the plaintiff to change its business position and to expand its manufacture and sales of the accused devices to customers, such as the defendant Chandler-Evans, and in so doing to indemnify them and hold them harmless from unanticipated infringement action brought by the plaintiff.
9. The 2,944,627 patent in suit is wholly void and invalid at law and equity for each or any of the following reasons:
 - (a) That the matter covered by the patent was not an invention and had no novelty at the time of its alleged invention, the differences, if any, between the matter in the patent and the prior art being such that the matter as a whole would

Answer and Counterclaim

have been obvious to a person skilled in the art to which the patent pertains.

- (b) With or apart from the allegations of the foregoing paragraph (a), the matter was known and used by others before the alleged invention thereof, it was patented or described in the hereinafter listed patents and publications in this and foreign countries before the alleged invention or more than one year prior to the application for the patent, it was in public use or on sale in the United States more than one year prior to the filing of the said application, it was not invented by the patentee himself, but before the purported invention by the patentee it was made by another who has not abandoned, suppressed or concealed it.

U. S. PATENTS

Number	Patentee	Issued
1,682,588	Wietzel, et al.	August 28, 1928
1,798,733	Hasche	March 31, 1931
1,844,563	Curtin	February 9, 1932
2,254,799	Erdmann	September 2, 1941
2,316,251	Kahle, et al	April 13, 1943
2,322,603	Thumim, et al	June 22, 1943
2,340,398	MacMullin	February 1, 1944
2,535,902	Dailey	December 26, 1950
2,702,826	Kirshenbaum, et al	February 22, 1955
2,765,868	Parks	October 9, 1956
2,800,197	Wynkoop	July 23, 1957
2,815,089	Turner	December 3, 1957

Answer and Counterclaim

FOREIGN PATENTS

Country	Number	Patentee	
France	795,497	Jaubert	—Application filed June 18, 1934; granted January 8, 1936; published March 14, 1936.
Germany	871,191	Kahle	—Application filed January 31, 1951; application published July 24, 1952; grant of patent published February 12, 1953; patent issued March 19, 1953.
Germany	882,541	Kahle	—Application filed August 8, 1951; application published October 9, 1952; grant of patent published May 28, 1953; patent issued July 9, 1953.
Germany	970,223	Kahle	—Application filed November 26, 1948; application published May 23, 1951; grant of patent published August 14, 1958; patent issued August 28, 1958.
Great Britain	633,137	American Magnesium Metals, Corp.	—Application filed February 19, 1947; accepted December 12, 1949.
Great Britain	677,150	Gesellschaft Für Linde's Eismaschinen	—Application filed November 25, 1949; published August 13, 1952.

(It is believed that other patents and/or publications will be located, and the defendants pray leave to identify them and add them with timely notice to the plaintiff. Such notice will also be given of the particular instances of prior knowledge, use, sale, or invention to be relied upon as evidence.)

Answer and Counterclaim

- (c) The specification of the patent does not contain a written description of the purported invention, and of the manner of practicing it, in such full, clear, concise, and exact terms as to enable a person skilled in the art to make and use the same.
- (d) The claims of the patent are broader than any invention made or disclosed by the patentee and are indefinite, functional and ambiguous and do not particularly point out and distinctly claim the purported invention.
- (e) The proceedings in the Patent Office during the prosecution of the application for the patent in suit and in filing a disclaimer therein, and the admissions and representations made by or on behalf of the applicant, now prevent the plaintiff from claiming for said patent a construction which covers or includes the acts of the defendants complained of herein.
- (f) That for purposes of deceiving the public and the Patent Office the description and specification filed in the Patent Office was made to cover less than the whole truth relevant to the purported invention and to cover more than was necessary to produce the desired effect. The Patent Office was further deceived by the filing of a Petition to make the application special on the allegation of infringement by the defendant Kahn with the clear implication that ir-

Answer and Counterclaim

reparable harm would be done if special handling was denied. The Patent Office was further deceived by failure of the applicant to cite for the record in the application all of the relevant prior art of which he had knowledge during the pendency of the application for the patent in suit.

(g) The patent was issued by the Patent Office without due and thorough investigation and, as evidenced by the Patent Office file history, important parts of the prior art were not cited or considered by the Patent Office, and the Commissioner of Patents exceeded his legal authority in granting the patent.

(h) After the grant of the patent, the plaintiff unreasonably delayed to enter a needed disclaimer.

10. The plaintiff has unclean hands, and, therefore, its patent 2,944,627 is unenforceable at law or in equity, particularly as against the defendant Kahn and its customers, including the defendant Chandler-Evans, for each or any of the following reasons:

(a) The plaintiff has, at least as early as April, 1964, conspired or attempted to conspire with others, notably E. I. DuPont de Nemours & Co., Inc., not to trade with Kahn in the subject matter of the patent, although such others, notably DuPont, were then fully indemnified by Kahn against patent infringement on the patent in suit. This conspiracy or attempt at con-

Answer and Counterclaim

spiracy was carried on by the plaintiff with promises to such others, notably DuPont, that the plaintiff would not involve them in litigation, and under the guise that the plaintiff merely wanted information on the Kahn structure, which information was long known to the plaintiff and formed the basis for the petition to have its application made special in the Patent Office in July, 1959. Further, at the time of such conspiracy or attempt at conspiracy the plaintiff had reason to know that its patent was invalid in view of prior art brought to the plaintiff's attention by the defendant Kahn, but the plaintiff did not disclaim its patent, choosing instead to use it in full bloom and with its accompanying presumption of validity to coerce others or to conspire with others, notably DuPont, not to trade with Kahn. As a result thereof such others, notably DuPont, despite the plaintiff's assurance that such others would not be involved, and despite indemnification by Kahn for involvement, have refused trade with Kahn and accepted trade with Kahn competitors more in favor with the plaintiff. This is thought to be in violation of the antitrust laws of the United States.

- (b) The plaintiff with information at hand, supplied at least in part by the defendant Kahn at least as early as 1961, and thereby knowing that its patent was invalid continued to seek out and to

Answer and Counterclaim

obtain licenses under its patent. Thereafter, on or about February 23, 1966, it disclaimed some of the claims of its patent as too broad, but failed to disclaim all that should have been disclaimed, all of this to the prejudice of all of its licensees.

COUNTERCLAIM

11. This counterclaim is for a Declaratory Judgment under 28 U.S.C. 2201 and 2202. The action upon which a judgment is sought arises under the patent statutes of the United States (Title 35 U.S.C.) and jurisdiction is thereby conferred by 28 U.S.C. 1338 (a) and (b).
12. On July 12, 1960 U.S. patent 2,944,627 was issued to the plaintiff.
13. The plaintiff in its complaint herein has alleged infringement by these defendants of the said patent, which is denied herein.
14. The defendants allege, by incorporation of paragraphs 9 and 10 hereof, that said patent is invalid and unenforceable.
15. Accordingly, there is an actual controversy between the plaintiff and the defendants as to whether said patent 2,944,627 is valid and infringed.
16. Further, the defendant Kahn alleges that the plaintiff has competed unfairly in its conduct as set forth in paragraph 10 hereof, said paragraph being incorporated herein by reference, and, upon information and

Answer and Counterclaim

belief, in other acts intended to harass Kahn's customers and prospective customers and to divert their business and prospective business from Kahn and otherwise to interfere with the business enterprise of Kahn.

WHEREFORE, the defendants seek:

- (1) That the Complaint be dismissed with prejudice.
- (2) That patent 2,944,627 be declared invalid and not infringed.
- (3) That the plaintiff be preliminarily and permanently enjoined from competing unfairly with the defendant Kahn.
- (4) That an accounting be ordered to determine the damages to which the defendant Kahn is entitled by reason of the acts of unfair competition and that such damages and the defendants' costs and disbursements, including attorney fees, be awarded.
- (5) That such other and further relief as is deemed just and proper be granted.

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Answer to Counterclaim

IN THE
UNITED STATES DISTRICT COURT
DISTRICT OF CONNECTICUT
Civil Action No. 12140

[CAPTION OMITTED]

PLAINTIFF'S ANSWER TO DEFENDANTS' COUNTERCLAIM

1. In paragraph 11 of defendants' Answer and Counterclaim, plaintiff admits that defendants allege that their counterclaim for a Declaratory Judgment under 28 U.S.C. 2201 and 2202 arises under the patent statutes of the United States, Title 35 U.S.C., and that jurisdiction is conferred by 28 U.S.C. 1338(a) and (b).
2. In paragraph 12 of defendants' Answer and Counterclaim, plaintiff admits that United States Letters Patent 2,944,627 was issued to plaintiff on July 12, 1960.
3. In paragraph 13 of defendants' Answer and Counterclaim, plaintiff admits that in its Complaint it charges defendants with infringement of United States Letters Patent 2,944,627 and that defendants allegedly deny said infringement.
4. In paragraph 14 of defendants' Answer and Counterclaim, plaintiff denies the allegations in paragraphs 9 and 10

Answer to Counterclaim

of defendants' Answer and Counterclaim that United States Letters Patent 2,944,627 is invalid and unenforceable.

5. In paragraph 15 of defendants' Answer and Counterclaim, plaintiff admits that there is an actual controversy between the plaintiff and defendants and that United States Letters Patent 2,944,627 is valid and infringed by defendants.

6. Plaintiff denies the allegations asserted by defendants in paragraph 16 of their Answer and Counterclaim.

WHEREFORE, PLAINTIFF PRAYS for the issuance of a Judgment that:

1. incorporates the prayer by plaintiff in its Complaint;
2. dismisses defendants' counterclaim, and
3. plaintiff be granted such other further relief as the equity of this case may require and as the Court may deem just and proper.

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Answer to Counterclaim.

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Stipulation

IN THE
UNITED STATES DISTRICT COURT

DISTRICT OF CONNECTICUT

Civil Action No. 12140

[CAPTION OMITTED]

IT IS HEREBY STIPULATED by and between the parties, through their attorneys, that if claims 9, 12, 14, 16, 17, 24 and 34 of United States Letters Patent No. 2,944,627 issued July 12, 1960 are held valid in accordance with Section 35 U.S.C., then said claims are infringed by heaterless dryers manufactured, sold and used by defendants.

All other claims of United States Letters Patent No. 2,944,627 are not being asserted as infringed by plaintiff nor challenged by defendant as being invalid.

March 20, 1973

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Transcript of Hearing Before Judge Blumenfeld

[1] UNITED STATES DISTRICT COURT

DISTRICT OF CONNECTICUT

Civil 12,140

[CAPTION OMITTED]

June 25, 1973

Hartford, Connecticut

Before :

HON. M. JOSEPH BLUMENFELD,

Chief Judge.

Appearances :

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By: ROGER B. McCORMICK, Esq. of counsel

Hearing Before Judge Blumenfeld

[2] The Court: Esso Research and Kahn & Co.

Now, I heard this case so you can take it for granted that I have a vague recollection about what was involved. Go on from there and pretend I remember everything.

Mr. McCormick: All right, your Honor.

The trial did take place from April 4th to April 12 and it was made known to the Court that Esso had a corresponding application pending in Germany at that time corresponding to the patent in suit here. There were five different parties opposed to the German application, as is permitted under German law.

On about March 30th of this year a German Patent Office tribunal rendered a decree or decision on the opposition. But this did not become known to the people representing the plaintiff and the defendants here until after the trial.

It is this decision which the defendants want to introduce into evidence as Defendants' Exhibit D-6 and its English translation as D-6A. I have them here. They have not been marked yet, your Honor.

Under the case law precedent we have cited in our memorandum it appears that this decision is [3] admissible, but in no way controlling upon this Court.

The Court: For what purpose is it admissible?

Mr. McCormick: As an admission against interest is what we are urging, your Honor. Because if I may go on, Esso in the prosecution of the opposition in Germany made these admissions against interest concerning the prior art.

We are not concerned with the ruling of the decision, but it is important to our case here because it quotes a patent claim filed by Esso in July, 1972 which constitutes this

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admission against interest and states a contrary position to the thrust of the evidence Esso presented here on the prior art.

The Court: This patent claim that it quotes was a patent claim made where?

Mr. McCormick: In Germany.

In Germany when an applicant such as Esso—

The Court: All right. They made a patent claim, quoted a patent claim, right?

Mr. McCormick: Yes. This was Esso's writing to the German patent tribunal, to the German Patent Office tribunal.

The Court: And said something about prior art?

Mr. McCormick: Yes sir.

Under the German practice when an applicant [4] such as Esso presents a claim—

The Court: All right. Was this statement with reference to prior art made before the patent was issued in this country?

Mr. McCormick: Yes sir.

Mr. Pomerantz: No.

Mr. Huettner: Your Honor, Mr. McCormick probably misunderstood your question.

Mr. McCormick: Wait a minute. Let's have the question again. I believe I did understand it.

The Court: Well, the question was whether this patent claim that made a reference to prior art, whether that claim containing that quote was filed prior to the issuance of the patent here.

Mr. McCormick: No.

I did misunderstand you.

Hearing Before Judge Blumenfeld

The Court: Yes.

Mr. McCormick: I understood your question to be was the prior art prior to the application and the patent.

The Court: All right. At any rate it was with reference to art prior to the issuance of the patent here?

Mr. McCormick: Yes sir.

I apologize, Mr. Huettner. I did misunderstand [5] your question.

You see, your Honor, in Germany when an applicant such as Esso presents a patent claim he is required to set out in this claim those elements or steps which he knows are old according to the prior art and he then defines his invention by stating it is characterized by those elements or steps which he thinks are his improvement over the known prior art. So all of this falls within a claim—

The Court: Aren't you supposed to do that in application for a patent before the U.S. Patent Office?

Mr. McCormick: The requirement is not identical in that.

The Court: Not as stringent in the U.S. patent?

Mr. McCormick: Not as stringent in the United States, no sir.

The Court: All right. So that is what you want to introduce?

Mr. McCormick: Yes.

The Court: You want the Court to take a look at it now?

Mr. McCormick: I want the Court to take a look at that.

The Court: In connection with the case that is [6] sub-judicated?

Mr. McCormick: Yes.

The Court: Very well.

Hearing Before Judge Blumenfeld

Mr. McCormick: May I finish, your Honor?

The Court: All right. What else is there? Do you have some authority for this? Is that what you want to call my attention to?

Mr. McCormick: Well, I want to call attention to the four elements or steps which they acknowledged as being old in the prior art while in Germany in 1972. There are four elements or steps which they formed the thrust of their evidence here as being novel.

The Court: First you want the Court to consider it?

Mr. McCormick: Yes sir.

The Court: And now you want to explain what it is, the significance of it; is that it?

Mr. McCormick: Yes sir.

The Court: Well, should I first rule on whether it's admissible, at this stage?

Isn't that what this motion is directed to simply, whether it is admissible at this stage of the case?

Mr. McCormick: Well, I think it is admissible, your Honor.

[7] The Court: Isn't that the sole thrust of this motion?

Mr. McCormick: No sir, not entirely.

The Court: To admit the genuineness—well, all right. What else? About the genuineness and the accuracy of the translation, is there any issue on that score?

Mr. Huettner: Yes, your Honor. We do not agree with the translation.

I think your Honor has hit the nail on the head when he says the issue before this Court at this time is whether or not this German opposition decision, or any part thereof, is admissible.

Hearing Before Judge Blumenfeld

The Court: Mr. Huettner, as I understand it, the only reason the decision comes in, if it does, is because within the scope of it there is a claim in connection with which your company is quoted as reciting some prior art.

Now, what decision the German Patent Office arrived at I don't suppose is of any materiality. But if this is the place in which this claimed admission is, then I suppose I ought to see it in that context.

Is that where it is?

[8] Mr. McCormick: Yes sir.

The Court: It appears in the decision?

Mr. McCormick: Yes sir, it does. It is quoted there within quotes.

The Court: Well, I mean then the decision is then the document which contains the admission?

Mr. McCormick: Yes sir. That's right.

The Court: If that's correct, you don't claim that it's an improper quote or an incorrect quote?

Mr. Huettner: No, your Honor.

The Court: No.

Mr. Huettner: The claim as it appears in the decision is correctly quoted and it is Esso's claim.

The Court: Yes.

Well, then I think in that form, in a proceeding to the Court, I will not exclude it on the ground that it comes in in the text of a decision.

Mr. McCormick: Do I understand, your Honor, that Mr. Huettner is also agreeing to the accuracy of the translation of that claim?

Hearing Before Judge Blumenfeld

Mr. Huettner: Your Honor, may I speak before you rule? Because there is an issue here of whether or not this is newly-discovered evidence.

[9] I would like to speak against the motion.

The Court: Well, all right. I'm just talking—

Mr. Huettner: I haven't had my opportunity—

The Court: All right. I'll give you a chance.

Mr. McCormick: Well, that still does not clear up whether Mr. Huettner is disputing the accuracy of the translation of that claim within the decision.

The Court: All right.

Mr. McCormick: Are you?

Mr. Huettner: I dispute the accuracy of the translation that Mr. Kahn has made, yes, your Honor.

Mr. McCormick: Well, I point out to the Court that Mr. Huettner and I were having exchanges here as to this passage, this claim as to its proper translation, and the translation that we are prepared to offer to the Court here is the translation which Mr. Huettner said was correct in these exchanges.

The Court: Well, I don't know. You invoked Mr. Kahn here. I don't care who made the translation. If there is an agreement on it that would satisfy me.

Is there an agreement as to what the German words mean?

Mr. Huettner: No, your Honor, there is not.

The Court: There is not.

[10] Mr. McCormick: Then, your Honor, I feel that I should have the opportunity to present evidence to support this translation because we did have exchanges. I had

Hearing Before Judge Blumenfeld

sent down a proposed stipulation over my signature with the translation of this passage.

The Court: Well, I want to tell you fellows something.

Mr. McCormick: Pardon me?

The Court: I think it's getting pretty silly if you are putting up to a Federal Judge to decide upon the correctness of one translation as against another in German patent law.

It certainly would seem that counsel of the caliber involved in this case could come to an agreement as to what the meaning of the language is. Is that impossible here?

Mr. Huettner: Your Honor, may I just speak to that point first.

Mr. McCormick, in his motion, has stated that—and I'm referring to page 2 of his motion, the paragraph beginning:

"Wherefore, it is respectfully requested that the Court order the plaintiff to admit the genuineness of a copy of the decree which defendants have and the [11] accuracy of defendants' translation thereof; or, in the alternative, to produce that which the plaintiff regards as a genuine copy of such decree and translation thereof."

If this Court does rule that the claim that appears in the decree is admissible, we will provide a translation that we will certify as genuine. And that is what he has asked in the alternative.

The Court: Well, I will hear you on why I shouldn't consider this evidence. So we will have to go step by step, I guess, Mr. McCormick.

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Let's hear Mr. Huettner on this. Why shouldn't the Court consider this as an admission, if it is such?

Mr. McCormick: Well, your Honor, may I add one more point?

I want to emphasize that this passage which appears at page 4 of the translation is the claim as Mr. Huettner presented it to me as being accurate.

It's not our original translation. It is the translation that he said, in the form of stipulation he sent to me, that he would live with.

The Court: Well, I don't know. You have to file that, if there is still a dispute about the translation.

But now why shouldn't the Court consider it?

[12] Mr. Huettner: Your Honor, the defendant has asked you to consider a claim that appears in an eleven page decision of a German patent office.

The Court: No. Just to consider a quotation in there attributed to your client which constitutes an admission with respect to prior art. That's all.

Mr. Huettner: Yes, your Honor. That is what is called the main claim. That is the only quote in this eleven page decision that is attributable to Esso.

The Court: All right.

Mr. Huettner: And, your Honor, it is a main claim. It's in the form of a claim. Like, you might quote in your decision Claim 1.

The Court: Right.

Mr. Huettner: That appears in the Patent Office decision.

That claim, your Honor, was inserted into the Patent Office proceeding in Germany on July 7th, 1972. It became

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public knowledge at that time and was accessible to all parties.

Mr. Kahn could have obtained the copy of that claim in 1972, your Honor; nine months before we commenced trial. It was available to him. It was public.

[13] Mr. Kahn apparently did not do so. Mr. McCormick, when we designated trial exhibits, your Honor, designated this particular patent, this German patent. He designated it in his list of exhibits to be introduced at trial as L-5. He designated this very patent in which this claim appears. He knew about it.

The Court: All right. That's the patent. Now—

Mr. Huettner: It was available at trial, your Honor.

The Court: Just a minute, Mr. Huettner. I want to understand. I have trouble enough with U.S. patent procedure, but now this is Germany.

This patent was available. This particular claim, was that quoted in the patent?

Mr. Huettner: Yes sir. It was inserted into the opposition as part of the patent on July, 1972. Ever since July 7th.

The Court: What did he insert into the patent?

Mr. Huettner: Your Honor, in the German procedure—

The Court: You start off with a patent and then see whether you can hold it?

[14] Mr. Huettner: That's correct.

What happens in Germany, your Honor, they issue a patent and then they publish it for people to oppose it.

The Court: I see.

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Mr. Huettner: And during that opposition proceeding one may amend his claims to avoid the opposition that is being created by the other parties.

The Court: All right. So it would depend then upon when he obtained his copy of the patent as to whether or not this claim would have been in there?

Mr. Huettner: Yes. Well, it was available to him, your Honor.

The Court: It became available on July 7th, 1972?

Mr. Huettner: 1972.

Mr. McCormick knew of the German opposition, your Honor, and back in 1970, when he took the deposition of Robert Pearlman, one of the witnesses at our trial here, he asked Mr. Pearlman what happened to the German application. And I am quoting from Mr. Pearlman's deposition of 1970. Mr. Pearlman stated to Mr. McCormick:

"But under German practice it is then open [15] to third parties to oppose the granting of the application. Such an opposition has been filed and is pending."

So Mr. McCormick knew the opposition was pending, he knew the patent in suit, and this is not new evidence. He could have obtained this evidence anytime he wanted to, your Honor.

The Court: But the evidence that you filed in July of '72—

Mr. Huettner: Was available to Mr. McCormick.

The Court: Where?

Mr. Huettner: In Germany.

He was obtaining copies because he obtained a copy of this decision within 21 days after it was rendered, your

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Honor. Mr. McCormick or Mr. Kahn had obtained a copy of the German opposition decision. These papers were available to him.

The Court: All right.

Mr. Huettner: Now, Mr. McCormick in his brief, your Honor, the brief before trial, was fully apprised of the entire German situation and I would like to have you refer to the last paragraph in his pre-trial brief in which Mr. McCormick stated:

"Defendants' counsel requests that plaintiff's counsel bring to trial plaintiff's file on the German [16] application or patent corresponding the patent in suit."

Your Honor, we had the entire file with us in this Courtroom during the trial. And this is what Mr. McCormick said before trial in his brief:

"The defendants believe that such a file contained statements relating to the prior art."

The Court: All right. Now, suppose all that is true. Why shouldn't the Court look at this evidence relating to prior art before deciding upon the validity of your patent?

I mean what is involved? How are you prejudiced in any way because of possible—well, let's be harsh about it and say laxity of counsel? I don't see how that prejudices your client any.

And, in addition, this is a matter that's invested with some public interest as to whether or not anybody should have a patent monopoly against all of the people in the country. So there is more of an interest in this than there is just between two private litigants.

Hearing Before Judge Blumenfeld

Furthermore, it comes up at a stage where it's not a new trial. It's not a question of newly discovered evidence. He just asks to reopen to admit some evidence that was inadvertently overlooked. [17] And I'll grant it. I'll grant that motion.

Now let's get to the point of the translation.

Mr. Huettner: Your Honor, am I correct that you are granting as to the claim that is quoted in the opinion? That is, Esso's admission?

The Court: You have told me, Mr. Huettner, that the claim as stated is accurate in that document.

Mr. Huettner: In German, yes.

The Court: Yes.

Mr. Huettner: Yes, your Honor.

The Court: It's accurate.

Mr. Huettner: That claim is called the main claim.

The Court: And I do not disqualify it because it happens to be in that document. I will accept the document and I'll ask the particular claim to be outlined.

Now, whether I should see or fuss with the rest of the document, I don't know. If there is real objection to that, that's something I'll hear you on. I don't want to be influenced by what the German court did about it, if I shouldn't be.

Should I be or not?

Mr. Huettner: May I ask that you would exclude the remaining, yes, your Honor, except for [18] the admission of the main claim. That we will agree upon.

The Court: All right. Well, let's see what your claim is with respect to that, assuming now we agree on the interpretation—on the translation, rather.

Hearing Before Judge Blumenfeld

Mr. McCormick: I think there's further acknowledgment needed in that the prior art before the German Patent Office at that time included five items of prior art that were before this Court.

The Court: You are saying that the German decision or opinion calls attention to those same items?

Mr. McCormick: Yes, five of the same items of prior art that were before this Court.

The Court: All right. Then I mean you are saying that there is no prejudicial effect likely to be caused if the Court sees the whole decision of the German court, is that it?

Mr. McCormick: Well, that is my position, your Honor. But if I may consult a moment with counsel.

The Court: Yes. All right.

Mr. Huettner: I differ diametrically with that one, your Honor. There is a prejudicial effect.

[19] The Court: You mean the German court reasoned from this in a way—

Mr. Huettner: The standard of invention, your Honor, and the application of prior art in Germany is different from that in the United States.

And, as you say, it's not going to influence you, but it is there.

It is not an admission of Esso and it's a patent office tribunal, it's not the court. It's like the Board of Appeals in the Patent Office.

And it's what they reason in Germany in accordance with German procedures and practice, which has no relevancy to our consideration of validity or infringement in the United States Courts.

But the admissions made by Esso which do appear in the main claim we, as you have ruled, will be translating.

Hearing Before Judge Blumenfeld

The Court: Well, you claim not that their reasoning isn't accurate or correct, but that the significance to be given to it legally is different?

Mr. Huettner: Your Honor, if you don't have all the documentary evidence leading up to the opinion, it is misleading.

Actually, your Honor, they make two determinations which are diametrically opposed in U. S. law.

[20] The Court: All right. They may not be a problem in that regard.

What about it?

Mr. McCormick: Well, we're willing to go along with the quoted portion from Esso, but we feel that the whole decision should be filed.

The Court need pay no attention to it. It has no bearing such as would be controlling at all on this Court because of the difference in the German patent law and that in the United States.

The Court: Well, does it make what is significant more readily understandable in the context in which it appears?

Mr. McCormick: Yes sir, it does.

The Court: All right.

Mr. Huettner: Your Honor, I strenuously request it doesn't make it any more significant because we are admitting an admission of Esso which is a main claim. It's a claim, your Honor. And what the opinion says does not influence that claim. It's a quoted claim. And I sincerely request the remainder of the decision—

The Court: All right. I'll accept the quoted portion.

Now the question is whose translation do I [21] accept?

You say, Mr. McCormick, that at one point Mr. Huettner agreed on a translation, is that correct?

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Mr. McCormick: Yes sir. And that's the translation I have here.

The Court: Well, what have you got to support that? Or does Mr. Huettner now deny that?

Mr. Huettner: No, I don't deny that at one point we had almost worked out a stipulation that I did write, your Honor, but it fell through at the very end within an hour after I thought Mr. McCormick and I had an agreement.

The Court: Well, did it fall apart because of a difference in translation or some other ground?

Mr. Huettner: The translation, your Honor, was a compromise.

It really is not—it's a compromise on both of our sides and it's not a good translation at all.

Mr. McCormick: But it is the compromise translation that Mr. Huettner was willing to accept and which we do accept and want to offer the Court.

Mr. Huettner: Your Honor, I would like to take the alternative of Mr. McCormick's motion and provide him with a certified translation of the claim as he has requested this Court to order in the [22] alternative.

Mr. McCormick: Certified by whom?

Mr. Huettner: Meissner? He has not seen this claim yet.

Mr. McCormick: I would suggest then, your Honor, that this can be handled this way: Let Mr. Huettner present his translation of this decree by Mr. Meissner, we present the translation by Mr. Kahn, and we would be willing to share the expenses of having a German translator advise the Court which is correct, the more accurate.

The Court: I'll accept that.

How long do you want?

Hearing Before Judge Blumenfeld

Mr. McCormick: Pardon me?

The Court: When can it be done?

Mr. Huettner: We can do this promptly. A week, if Dr. Meissner is available. I haven't talked to him since the trial.

Mr. McCormick: Our translation is ready now.

The Court: Yes. But you may have to get your own umpire to decide which one is the more correct between Meissner's and Kahn's.

Mr. McCormick: Well, we would suggest, your Honor, anybody acceptable to the Court.

The Court: Well, leave me out of it here. You [23] may be back at the compromise before you're through.

Mr. Huettner: May we have two weeks to resolve this problem, your Honor?

The Court: All right. Two weeks.

Mr. McCormick: Your Honor, two weeks puts us over into the summer and I think we ought to have this case decided eventually. This has been dragging on since the first accusation in 1960. I think we should be able to handle this this week.

The Court: Fine. All right. I'll accept it as soon as you have it.

Anyway, it all goes along with the briefs that are still due.

Mr. McCormick: Right.

We are aware that the Connecticut Manufacturers' Association has translators of people who translate German literature there.

The Court: If you will make that decision out in the hall. I am through with this case.

Next matter.

Letter to Judge Blumenfeld

(Letterhead of McCormick, Paulding & Huber,
Hartford, Connecticut 06103)

Honorable M. Joseph Blumenfeld
Chief Judge, U. S. District Court
450 Main Street
Hartford, Connecticut

Re: Esso v. Kahn et al
Civil Action 12140

Dear Judge Blumenfeld:

Subject to your approval, the parties have agreed:

1. That only the "admission" or main claim submitted by Esso and quoted within the decision of the German Patent Office tribunal will be admitted into evidence from that decision, this claim having been submitted to the German Patent Office in July, 1972.

2. That the translation of that main claim agreed upon by the parties reads as follows:

"Process for separation of one or more components from gaseous mixtures by selective adsorption and subsequent desorption at substantially the same temperature wherein one of several adsorbing beds are alternately charged during an adsorption phase by introduction of the feed gas and withdrawal of the non-adsorbed product gas, and wherein a desorption phase at a lower pressure desorbs the adsorbing bed by feeding in counter-current direction a part of the fractionation product

Letter to Judge Blumenfeld

as purge gas, characterized in that one uses as purge gas a part of the product gas directly recovered from the adsorber and one adjusts the duration of the respective adsorption and desorption phase to a time period of not more than 2-3 minutes each, for adiabatic use of the sorption heat as well as for formation with the phase alternation of an oscillating loading front, known per se, in a middle section of each bed."

3. That in view of a necessary trip abroad by the plaintiff's resident counsel, Mr. Pearlman, it is respectfully requested that the time for filing briefs by both parties be extended from August 8 to August 31, 1973, with the further understanding and agreement that no further briefs will be submitted by either party unless specifically requested by the Court.

Respectfully,

/s/ ROGER B. McCORMICK
Roger B. McCormick
for the Defendants

July 31, 1973

/s/ RICHARD A. HUETTNER
Richard A. Huettner
for the Plaintiff

August 1st, 1973

Memorandum of Decision**UNITED STATES DISTRICT COURT****DISTRICT OF CONNECTICUT****Civil No. 12,140**

[CAPTION OMITTED]

Esso Research and Engineering, plaintiff in this action, is a wholly owned and controlled affiliate of the Exxon Corporation (formerly known as Standard Oil of New Jersey, Inc.). Plaintiff is incorporated under the laws of the State of Delaware and has its principal place of business in New Jersey. It is engaged in research and engineering work for Exxon and its parent's other affiliated companies. It does not manufacture or sell any products to third parties. Plaintiff does, however, have a combined patent and licensing department which licenses technology originating or controlled by the company.

Defendant Kahn and Company, Inc. is a corporation located in Wethersfield, Connecticut, where it maintains its main offices and also has manufacturing facilities. Kahn and Company, Inc. is engaged in the manufacture and sale of various commercial and institutional driers and gas separators as well as other test equipment and measuring devices.

Defendant Chandler-Evans, Inc. is incorporated under the laws of the state of Delaware and maintains a regular and established place of business in West Hartford, Connecticut, where it operates a Kahn and Company heaterless drier for the removal of moisture from air.

*Memorandum of Decision**Jurisdiction*

Plaintiff, as assignee of Charles W. Skarstrom, is the owner of U.S. Letters Patent 2,944,627 for Method And Apparatus For Fractionating Gaseous Mixtures by Adsorption. Plaintiff alleges that defendant Kahn and Company, Inc. has induced infringement of plaintiff's patent by its manufacture and sale of infringing devices to defendant Chandler-Evans, Inc., and has itself infringed and contributorily infringed said patent by its manufacture and sale of heaterless driers within the jurisdiction of this Court.

This action arises under 35 U.S.C. §§ 271 and 281. This Court has jurisdiction under 28 U.S.C. § 1338(a). The Court is a proper venue for this action by virtue of 28 U.S.C. § 1400(b).

I.*Preliminary Analysis*

Entitled "A Method And Apparatus For Fractionating Gaseous Mixtures by Adsorption," the Skarstrom U.S. Patent No. 2,944,627 describes a process for the separation of one gas from a mixture of gases through selective adsorption by performing a combination of specific designated steps in a particular sequence and manner under defined conditions. Defendants admit that they perform each and every step described and defined in the Skarstrom patent in the same sequence and manner and admit that they obtain the same result as specified in claims 9, 12, 14,

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16, 17, 24 and 34. These are method claims. Both defendants Kahn and Company, Inc. and Chandler-Evans, Inc. have entered into a stipulation stating that if said claims are valid in accordance with the patent laws then the claims are infringed by heaterless driers manufactured and sold by defendants.

Defendants challenge the validity of the claims in suit on the ground that they are invalid because they do not satisfy the requirements of non-obviousness as set forth in 35 U.S.C. § 103, see note 4, *infra*, in that the subject matter of the Skarstrom invention "and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains."

History

The invention of the patent in suit was made in September 1956 at plaintiff's laboratories. At the time of the invention various methods for the separation of one gas from another were well known and long in existence.

The specification of the '627 patent commences with a general description of the invention as being one which describes a method and apparatus for removing one gas from a mixture of gases. It then goes on to describe that "one specific adaptation of the invention relates to the drying of a gaseous mixture, such as air by removal of water vapor." Although the patent in suit is in no way limited solely to the removal of water vapor from air the

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patentee selected this example to describe and explain the operation of his invention.¹

Dr. Skarstrom's Development

Dr. Charles W. Skarstrom, a graduate chemist from Columbia University and the University of Virginia, was employed by the plaintiff for approximately 27 years prior to his retirement in 1970. During that time he had been studying and devising ways to separate gases and measure the separations accomplished thereby. In 1956, immediately prior to the invention in suit, Dr. Skarstrom was working on a water analyzer and also on an analyzer to determine the composition of bottled gas during its manufacture. Both of these projects required dry air, and, consequently, Dr. Skarstrom had conventional, commercially available driers in his laboratory at the Bayway Refinery in Linden, New Jersey.

These particular driers were of the then common, everyday type of commercial drier, known as the heat regenerating drier, operating on twelve-hour cycles. They removed water from the air by passing moisture-laden air through an enclosed bed of desiccant at high pressure where the desiccant adsorbed the moisture; the dry product air, still

¹ Analysis of the method as applied to a specific gas, water vapor, imparts a sharper focus to a discussion of the issues. The removal of water vapor from air in effect dries the air. Under normal atmospheric conditions where the temperature is about 70° and the relative humidity is 50%, the surrounding air will contain about 10,000 parts per million of water vapor. Stated in another way the surrounding air would contain somewhere around 1% by volume water vapor.

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at high pressure, continued on through a pipe leading from the top of the bed. Although this drier had two beds of desiccants, and was referred to as a two-bed drier, it is more accurately described as a pair of driers, each a mirror image of the other, each being used alternately to remove water vapor from separate feeds of moist air, and so connected to each other as to provide reciprocally a portion of the dried product gas to each other. Before the time that one bed became saturated with water, the stream of air to be dried was switched to a feed pipe leading to the other bed. Meanwhile, heat was used to evaporate the moisture out of the saturated desiccant. The most common method employed a heater within the desiccant itself.

Dr. Skarstrom's unit had such internal heaters. During regeneration of a saturated desiccant bed the heaters, in conjunction with a counterflow of some of the dry product gas called "purge gas," would remove the accumulated moisture from the desiccant bed leaving it ready for a subsequent adsorption operation. Thus, while one bed was adsorbing, the other one was being desorbed.

One day in 1956 when Dr. Skarstrom was conducting his experiments on analyzers, the heater in one of the drier beds burned out, thereby incapacitating the unit's normal operation. This incident led Dr. Skarstrom to decide that he would attempt to operate the drier without a heater.

The particular drier in question was a two-bed, heat regeneration drier manufactured by Trinity Corporation and similar to the Skarstrom driers shown in P. Exs. 4A and 4B (see Appendix). The normal cycle time for this Trinity drier was 12 hours, to wit, 6 hours on stream adsorbing, 3 hours desorbing by heat regeneration and counterflow of

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purge gas, and 3 hours for a resting or a cooling down period. The first thing Dr. Skarstrom did with his broken down drier was to replace the timer element. He used a gear he happened to have in his laboratory to decrease the cycle time from 12 hours to a markedly shorter cycle of 30 minutes on adsorption and 30 minutes on desorption (without heat), and eliminated the cooling period as unnecessary. Dr. Skarstrom found that the drier could in this fashion do some drying even without the use of heat. Dr. Skarstrom next reduced the 30-minute cycle to 20 minutes and found that the product was even drier.

Dr. Skarstrom then directed his attention to the amount of purge gas that was used during the regeneration step. The gas not diverted for use as purge gas continued on under pressure as product; the diverted purge gas passed through a valve to the pipe at the top of the bed to be desorbed, where it was reduced to atmospheric pressure. It then flowed down through the desorbing desiccant bed and out into the atmosphere. The drier as provided to Skarstrom by the Trinity Corporation specified that about 3% of the product gas be used for purge. When in normal use Dr. Skarstrom observed that with the heater in operation the drier actually required only about 2% of the dry product gas to be diverted in order for that relatively small stream of purge gas to effect the complete desorption of water from a desiccant bed in conjunction with the heating of that bed. In modifying his disabled drier, Dr. Skarstrom increased the amount of purge gas diverted from the flow of product gas by substituting a new purge valve system which stepped-up the purge flow 25-fold, so that fully half of the product gas was diverted for use as purge gas.

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By further experimentation, he determined that satisfactory results could be obtained through diversion of only 25% of the product gas as purge gas.

Dr. Skarstrom further refined his apparatus by changing the purge piping arrangement to provide an even quantity of purge gas at a steady flow rate. He continued to reduce his cycle time, to 11 minutes and then down to 3 minutes, until eventually, in his words, "the product became quite dry and I was very pleased." He termed the Trinity heater-type drier on which he had experimented "very much like" the model heaterless drier of the patented apparatus used to display the patented method, "only it had heaters in it."

In brief, the method described in the patent in general terms contemplates the removal of water vapor from air² in a drier containing a pair of desiccant beds. Each of these are used in the same way to adsorb water vapor, but only one at a time is being fed moist air under pressure. In operation, the moist feed air is introduced at high pressure through a pipe to the bottom of one bed (bed on the right side in Ex. 4B shown in the Appendix). As it flows through that bed it is dried by the desiccant's adsorption of its water vapor, and it is then passed along as dry product air through another conduit leading from the top of the bed, still at high pressure. A valve in that conduit diverts a portion of the dry product air to the pipe leading from the top of the drier on the left side where it is relieved of pressure, flows down through the pipe at the top

² As previously indicated, this is the example chosen by the parties to illustrate the removal of one of the key components from a gaseous mixture.

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of the desiccant bed on the left side, through the bed and then on through the conduit below that bed and out to the open air. As it flows down through that bed it desorbs previously collected water vapor from the desiccant in that bed, again becoming moist air, and is discharged.

In continuing operation of the apparatus, the left and right beds are alternated on adsorption and desorption at the selected cycle time, cycle after cycle. The cycle time selection is quite flexible and will vary with conditions such as the size of the beds, the desiccant being used, the key component (such as water vapor) being adsorbed, the gaseous mixture (such as air) from which it is being separated, and the total amount or degree of separation desired.

Dr. Skarstrom stressed that it is important to select a cycle time "at less than that required to secure complete saturation" of the adsorbing bed. If complete saturation of the adsorbing bed occurs, it would no longer adsorb the water vapor and the process would fail. Since some heat is given off into the bed on adsorption the cycle time should be sufficiently short to permit the process to function without the addition of heat, as from an imbedded electrical heater, to aid the desorption. Thus, in order to make the process work heaterlessly, the adsorbing bed must be switched to desorption before it loses the heat of adsorption, so that the heat of adsorption may be employed to assist the desorption. In other words, the cycle time should be sufficiently brief so that there is no significant change in temperature in either of the beds when adsorbing and being desorbed. The patent states that it can be in the order of seconds or minutes.

This concept of maintaining a substantially constant temperature during adsorption and desorption dictates that

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during each cycle the same amount of water vapor must be purged or desorbed from a bed as was just adsorbed by the bed. This will insure that the same amount of heat will be given up by a bed during its desorption cycle as was generated during its immediately preceding adsorption cycle. If this equilibrium is not maintained cycle after cycle, heaterless operation will eventually fail because an incremental temperature change in one direction or the other will ultimately make a bed either too hot for successful adsorption or too cold for successful desorption.

II.

The plaintiff's brief has translated into more easily understandable language the specialized jargon used by the patent attorney in stating what in the above described method is claimed as being patentable.

"The Skarstrom invention is:

A completely self-contained, self-regenerating gaseous fractionating process utilizing a selective adsorbent in which the adsorbent bed is the sole agent for fractionation and heat exchange which comprises:

- (1) a repetitive adsorption/desorption process utilizing differences in pressure;
- (2) wherein gaseous feed is introduced at one end of the adsorbent bed and product effluent recovered at the other end;
- (3) a part of the product effluent is used to desorb the bed (or essentially the same product effluent from a paired companion bed on a complementary cycle);

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- (4) by counter-current flow at lower pressure than the adsorption pressure;
- (5) with cycle times sufficiently short so that heats of adsorption/desorption are substantially retained and balanced within the adsorbent bed;
- (6) the adsorption/desorption being effected so as to create an oscillating concentration front which remains in the adsorbent bed with only a fraction of the adsorbent bed being utilized for the most of the adsorption/desorption;
- (7) said process operating so as to eliminate the need for any supplemental heat exchanges; and
- (8) the need for any external purge gas supply."

These allegedly unique steps in the Skarstrom process upon analysis can be distilled to four:

1. Repetitive adsorption and desorption at short cycle time at substantially the same temperature, thus to eliminate the need for heaters.
2. Adsorption being at high pressure, and desorption at low or atmospheric pressure.
3. A portion of the dry product being used in reverse flow as the purge gas.
4. The adsorption and desorption creating an oscillating front within each bed.

The explanation of the results obtained under the Skarstrom method is founded largely on previously known scientific principles.

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Use of a heater not necessary. The plaintiff's expert testified that it has long been known that the adsorbing bed becomes heated as a result of adsorbing, and in desorbing it must give up heat. For it to retain sufficient heat for the desorption stage, the adsorbing bed must be desorbed before the heat created by adsorption is lost by dissipation. Thus the cycle time should be sufficiently brief so that no significant amount of the heat created during adsorption is lost by conduction through the walls of the bed before the switch from adsorption to desorption.

Adsorption at high pressure and desorption at low pressure. It is obvious that if a drier is to yield a net amount of product gas, all of the product gas dried during the adsorption cycle cannot be diverted back through the desorption cycle for use as purge gas. Both parties presented evidence that two of the fundamental laws of the behavior of gases account for the ability of the Skarstrom drier to function successfully using only one quarter of its product gas as purge gas. Boyle's Law dictates that at any given temperature the volume of a gas varies inversely with its pressure. Dalton's Law provides that the total pressure of a mixture of gases is the sum of the partial pressures of the individual gases in the mixture, and hence that a change in the partial pressure of one gas in a mixture, with a consequent change in the total pressure of the mixture of gases, has no effect on the partial pressures of the other gases in the mixture. Boyle's Law means that only one quarter of the product gas is needed to flow back through the desiccant as purge gas, if the 60 pounds per square inch pressure of the product gas is reduced to 15 pounds per square inch for its use as purge gas. And Dalton's Law means that the

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partial pressure of water vapor which the purge gas can carry with it without becoming saturated, is the same whether the purge gas is at 15 or at 60 pounds per square inch pressure. Thus the counterflow of purge gas at 15 pounds per square inch of pressure back through the desiccant during the desorption cycle can carry as much moisture with it back into the atmosphere as was imparted to the desiccant by the moist feed gas which flowed through the desiccant at 60 pounds per square inch pressure during the adsorption cycle.³ In their explanation through their respective experts of the Skarstrom drier's dependence on Boyle's and Dalton's Laws, neither party suggested that the Skarstrom drier represented a novel application of these fundamental principles or achieved theretofore unpredictable results. It should also be noted that the commercial Trinity air drier on which Dr. Skarstrom experimented was equipped by its manufacturer with valves and conduits for withdrawing a portion of the dry product gas as it was being produced, and the function of these parts was to permit a portion of the dry product gas to be withdrawn and allowed to expand in volume for use as a washing gas during desorption. Plaintiff itself recognized in its brief: "During regeneration the heaters (in the Trinity drier) in conjunction with a counterflow of washing gas would drive out the accumulated moisture and prepare the dessicant bed for a subsequent adsorption operation."

³ Atmospheric pressure is 14.7 pounds per square inch. Although the evidence did not touch on this point, presumably the purge gas must be under a pressure somewhat higher than this in order to insure that the purge gas does indeed flow out through the desiccant to the lesser pressure of the atmosphere outside.

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III.

In determining whether the patent in issue is invalid by application of § 103⁴ in "that the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains," several aspects must be separately considered. As outlined by the Supreme Court in *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966), the formula by which non-obviousness is to be tested is as follows:

- "[1] [T]he scope and content of the prior art are to be determined;
- [2] differences between the prior art and the claims at issue are to be ascertained; and
- [3] the level of ordinary skill in the pertinent art [is to be] resolved.
- [4] Against this background, the obviousness or non-obviousness of the subject matter is determined."

See also *Monoplastics, Inc. v. Caldor, Inc.*, 264 F.Supp. 57, 59 (D. Conn. 1966), aff'd 378 F.2d 20 (2d Cir. 1967).

⁴ 35 U.S.C. § 103 provides:

"A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made."

*Memorandum of Decision**The Prior Art*

"... [T]he proper way to apply the [§] 103 obviousness test to a case like this is to first picture the inventor as working in his shop with the prior art references—which he is presumed to know—hanging on the walls around him." *Application of Winslow*, 365 F.2d 1017, 1020 (C.C.P.A. 1966).⁵ The complete knowledge of prior learning in the art of fractionating gaseous mixtures which an inventor "having ordinary skill in the art" must be regarded as having would include knowledge of Boyle's Law, Dalton's Law, and the thermodynamic characteristics of fractionation. While these laws were cited to explain scientifically how use of the patented process desorbs the desiccant beds which dry the air, the scientific explanation of what takes place cannot be patented. *DeForest Radio Co. v. Gen'l Electric Co.*, 283 U.S. 664, 684-685 (1931); *Aetna Steel Products Corp. v. Southwest Products Co.*, 282 F.2d 323, 334 (9th Cir. 1960), *cert. denied* 365 U.S. 845 (1961). Most pertinently, as part of the prior art the inventor had at hand an air drying device which was already rigged with a pair of desiccant beds and a timing device which regulated operation in a repetitive alternate cycle and valves which diverted a portion of the dried air under pressure into a pipe large enough to permit the gas to expand to atmospheric pressure, thus increasing its volume by a factor of at least four, whereupon as "washing gas" or "purge gas" it flowed through a wet desiccant bed functioning as a

⁵ But see *Application of Antle*, 444 F.2d 1168, 1171 (C.C.P.A. 1971), limiting the applicability of this simile to cases, such as the instant case, where the prior art is in the inventor's field of endeavor.

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desorption agent to dry out the bed and make it ready for adsorption again.

In addition to the demonstrative teaching in the art of drying air furnished by the commercial drier made by and purchased from the Trinity Corporation, there was other learning which would have to be attributed to the hypothetical person "having ordinary skill in the art." A substantial amount of prior art was developed by Kahle, an earlier German inventor, and disclosed by him in publications. The most significant of these are German Patent 970,223, German Patent 871,886, and the *Chemie Ingenieur Publication* of 1953. None of these were cited by the patent office against the Skarstrom patent. These deal specifically with methods of fractionating gas. The fact that there was prior art not considered by the patent office is sufficient to dissipate the presumption of validity which otherwise would be attributed to a patent. See *Monoplastics, Inc. v. Caldor, Inc.*, *supra*, at 62-63.

*Differences Between Prior Art
and Claims at Issue*

Circumstances not usually present in litigated patent cases pointedly establish which claims the patentee contends are not disclosed in prior art. During the prosecution of Dr. Skarstrom's application, Esso's United States patent department was also prosecuting an application for a German patent in the Skarstrom invention through Esso's German patent agent. Under the German procedure, a patent is tentatively issued and published, so as to permit other parties to oppose its final grant.⁶ During that opposi-

⁶ In this country it is only after litigation that the validity of issued patents can be conclusively determined.

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tion proceeding the applicant may amend his claims to avoid the opposition that is offered by the other parties. That was done by Esso in those German proceedings, in July 1972, when it submitted the following claim to the German Patent Office:

[“Process for separation of one or more components from gaseous mixtures by selective adsorption and subsequent desorption at substantially the same temperature wherein one of several adsorbing beds are alternately charged during an adsorption phase by introduction of the feed gas and withdrawal of the non-adsorbed product gas, and wherein a desorption phase at a lower pressure desorbs the adsorbing bed by feeding in countercurrent direction a part of the fractionation product as purge gas,] characterized in that one uses as purge gas a part of the product gas directly recovered from the adsorber and one adjusts the duration of the respective adsorption and desorption phase to a time period of not more than 2-3 minutes each, [for adiabatic use of the sorption heat as well as for formation with the phase alternation of an oscillating loading front, known per se, in a middle section of each bed.”]

In German patent law, as Esso was advised by its German patent agents, Esso was required to acknowledge the state of the prior art in its German claims by first stating at the beginning of any claim those steps known in the prior art and thereafter asserting in a “characterizing” clause what it claimed was novel. Thus everything within the first set of brackets in the quoted portion was admitted

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by Esso to be relevant prior art. Secondly, if anything mentioned in the "characterizing" clause was old, this must be disclosed as "known per se." Since everything within the second set of brackets was accordingly admitted by Esso to be not new or novel, this matter could not satisfy the conditions of patentability imposed by our law in 35 U.S.C. §§ 101 and 102. See *Graham v. John Deere Co.*, *supra*, 383 U.S. at 12.

It should be emphasized here that, in considering what Esso submitted to the patent authorities in Germany as its claim, this Court is primarily concerned first with Esso's own admissions of the scope and content of the prior art and second with its analysis of the differences between the prior art and its claims for a patent, not with the decision the German Patent Office made with respect to patentability. For although the procedure in Germany for testing the validity of a patent is different from ours, the factors considered in applying the test for non-obviousness of § 103 are in substance the same. The Supreme Court has directed in *Graham v. John Deere Co.*, *supra*, 383 U.S. at 17, see p. 15 [p. 51a of Joint Appendix], *supra* that the scope and content of the prior art are to be determined and the differences between the prior art and the claims at issue are to be ascertained. What Esso submitted in Germany sheds considerable light on these two aspects of the inquiry.

Having thus carefully restricted its contention that there is no prior relevant art to only those unbracketed elements of the method, which call for (1) the use of a part of the product gas directly recovered from the adsorber as "purge gas" and (2) the adjustment of the adsorption and desorption cycle to a time period of not more than 2-3 minutes

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each, the question still remains whether there was prior art relevant to these two elements of the claim. While the claim submitted in Germany by Esso can be regarded as an admission against its interest, it was still self-serving. Firstly, insofar as the use of a part of the product gas as "purge" gas is concerned, the Trinity two-bed drier upon which Skarstrom conducted his experiments did just that, although the proportion of product gas diverted as purge gas was relatively small. See pp. 5-8, 14 [pp. 43a-45a, 50a of Joint Appendix], *supra*. Furthermore, the article by Kahle in the *Chemie Ingenieur* Publication of 1953 (#22) disclosed at page 148, left. col., ¶ 2, lines 7-10: "One can also use as a purge gas, a partial flow of the clean gas branched off downstream from the adsorbent."

Secondly, it is not surprising that a cycle time of 2-3 minutes is not specified in prior art references, in view of Skarstrom's own statement that "The particular times utilized depend upon various factors such as the particular adsorbent utilized, the height of the bed, the nature of the key component, and other variables." Skarstrom patent, Col. 7, lines 12-15. Nonetheless the British patent 633,137 does disclose a 3-minute cycle time. The subject matter of all of the prior art referred to was the fractionation of gases, so there can be no doubt about its relevance.

The Level of Ordinary Skill in the Art

The hypothetical person described by § 103 as having ordinary skill in the art is assumed to possess a detailed knowledge of all there is to know in his own field, for the concept underlying § 103 is that a patent shall not be issued

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for ways of doing things which are not really new or which do not add to what was known before. One of "ordinary skill" in the art is chargeable with comprehensive knowledge of the art, *Continental Can Co. v. Crown Cork & Seal Co.*, 415 F.2d 601, 603 (3d Cir. 1969), *cert. denied*, 397 U.S. 914 (1970). Thus it does not matter whether Dr. Skarstrom had acquired this knowledge so long as it was published, *cf. Hazeltine Research, Inc. v. Brenner*, 382 U.S. 252 (1965), and this is without regard to whether the relevant references were of foreign or domestic origin. *Application of Baum*, 374 F.2d 1004, 1009 (C.C.P.A. 1967). Moreover, the hypothetical "person having ordinary skill in the art" does not deserve that ancient tag about facts passing from the notebook of the teacher to the notebook of the student without passing through the mind of either, for he must be held accountable not only for specific teachings of references, but also inferences which those skilled in the art may reasonably be expected to draw. *Application of Hoeschele*, 406 F.2d 1403, 1407 (C.C.P.A. 1969).

Non-Obviousness

Taking a kind of a grandstand view of what Dr. Skarstrom did to arrive at the patented method, it appears that, when his routine research to determine the composition of bottled gas was interrupted by the failure of the heaters in the Trinity drier which he was using as a tool, he turned his attention to that drier to see if he could not make it do its job without them. Then by an empirical approach he shortened the cycle time, and solely using part of the product gas as purge gas he achieved desorption without the addition of any heat. And as noted

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above, these are the specific contributions to the method which Esso claims are new. If these were not directly taught by the prior art, the differences are certainly not outstanding.

In determining whether Dr. Skarstrom's adjustments to the process employed by the Trinity drier merit the grant of a patent, the Court has been instructed on the criteria to be used in testing for non-obviousness and must exercise strict observance in applying them. *Graham v. John Deere Co.*, *supra*, 383 U.S. at 18-19; *Anderson's-Black Rock, Inc. v. Pavement Salvage Co., Inc.*, 396 U.S. 57, 62 (1969). Since to be patentable, "[a] discovery or devising must add something of significance, though not necessarily very much, to scientific knowledge if it is to take on the quality of invention under a statutory scheme which gives the inventor, for a number of years, a legally protected monopoly in a legal order which generally abhors monopoly," *Packwood v. Briggs & Stratton Corp.*, 195 F.2d 971, 973 (3d Cir. 1952), *cert. denied* 344 U.S. 844, Dr. Skarstrom's fractionation process falls short of the mark. Compare *American Potato Dryers v. Peters*, 184 F.2d 165, 170 (4th Cir. 1950), *cert. denied* 340 U.S. 930 (1951). All of the steps he took led in the directions which the prior art would lead one to expect. There was no sudden breakthrough which opened up exciting possibilities for the future. Qualitatively, his method produced no result different from that of the Trinity drier. And, since quantitatively the Skarstrom method used ten times as much of the product gas for purging (25% as against 2%), the use of heaters in the Trinity drier was not entirely a negative step.

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It may be that Dr. Skarstrom was pleased when he discovered that he could use the Trinity drier without the aid of heaters, but this does not mean that he must be rewarded with a patent, for neither his, nor the court's objective reaction has any place in the test which must be made. Obviousness is a legal conclusion which the court is required to draw from the facts appearing of record. *Application of Lettvin*, 339 F.2d 249, 251 (C.C.P.A. 1964). In deciding the judgmental issue against the background of what is set out above, it is clear that what the patentee did was simply a matter of following the prior art in a logical way, applying those insights which would suggest themselves to one skilled in the art. The prior art pointed to the use of purge gas for desorption, and if no additional heat was to be supplied, the use of more purge gas was certainly not an unobvious step to take. Since it was well known that heat was generated in the bed on adsorption, it was not non-obvious to speed up the cycle in order to desorb before the bed, heated by adsorption, had cooled off.⁷ In Kahle's

⁷ Although Dr. Skarstrom may have been unaware of the fact that whatever changes he made had been previously pointed out by Kahle to those interested in the process of fractionating gases, that cannot be said of Esso's patent counsel who were prosecuting his application for a patent. When a tabulated comparison between what Kahle had done and what Esso proposed to claim in Germany was made by Esso's U. S. patent department, the similarities were made clear, and differences sought by Esso were negated by Esso's German patent in dialectic interaction. See Def.'s Ex. V(5). This comparison revealed an awareness that Kahle's 1953 article disclosed a heaterless drier. Furthermore, in criticism of the tabulated comparison, Esso's German patent agent wrote to Esso:

"I agree to the tabulated comparison of the features of the invention and the Kahle references with two exceptions. Firstly, in my opinion there is no doubt that German patent 970,223 discloses the method of cyclical heat conservation.

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British Patent 677,150, counterpart of German 970,223, it is specified that "owing to the short adsorption desorption time, practically the whole heat of the adsorption process remains in the adsorber and is consequently usefully employed for the subsequent desorption." What Dr. Skarstrom did showed technical competence, but was far short of scientific innovation. From the standpoint of science his method does not add more knowledge or shape what was known before into greater order or harmony. And, unless no attention is paid to what had already been disclosed by Kahle, his perception of how technologically to apply that learning was not something non-obvious to a person having ordinary skill in the art of fractionating gaseous mixtures. It follows that the Skarstrom method did not rise to the level of patentability. Had the prior art which was before this Court been before the patent examiner who processed the application, it is most unlikely that he would have granted the patent.

As Mr. Justice Douglas noted in *A & P Tea Co. v. Supermarket Corp.*, 340 U.S. 147, 154-155 (1950) (concurring opinion):

"Every patent is the grant of a privilege of exacting tolls from the public. The Framers plainly did not want those monopolies freely granted. The invention, to justify a patent, had to serve the ends of science

Moreover, both German patents 871,886 and 970,223 as well as the Kahle article (1953) clearly disclose that adsorption and desorption are effected *at the same temperature*. Secondly, cyclical heat conservation is a result rather than a teaching of the operating conditions. For both reasons the cyclical heat conservation itself will hardly provide a distinguishing feature."

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—to push back the frontiers of chemistry, physics, and the like; to make a distinctive contribution to scientific knowledge. That is why through the years the opinions of the Court commonly have taken ‘inventive genius’ as the test. It is not enough that an article is new and useful. The Constitution never sanctioned the patenting of gadgets. Patents serve a higher end—the advancement of science. An invention need not be as startling as an atomic bomb to be patentable. But it has to be of such quality and distinction that masters of the scientific field in which it falls will recognize it as an advance.”

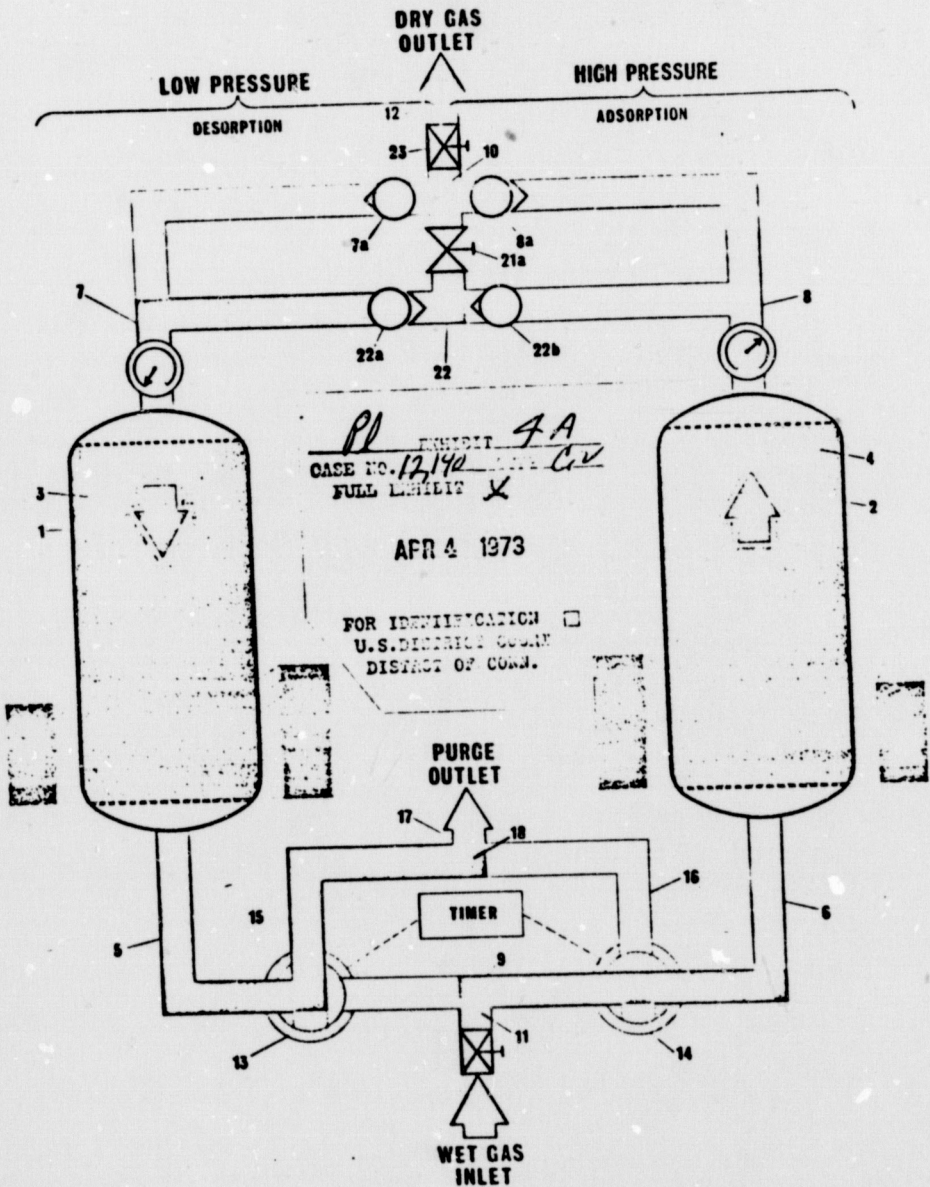
I conclude that the Skarstrom patent in issue does not meet the non-obvious test for patentability set forth in 35 U.S.C. §103. It follows that the defendant cannot be held liable for infringement of an invalid patent. And since this is dispositive of the case, there is no reason to reach the other issues raised by the defendant. Accordingly, the defendant is entitled to a judgment dismissing the complaint and declaring that U. S. Letters Patent No. 2,944,627 is invalid, and it is

So ORDERED.

Dated at Hartford, Connecticut, this 30th day of April, 1974.

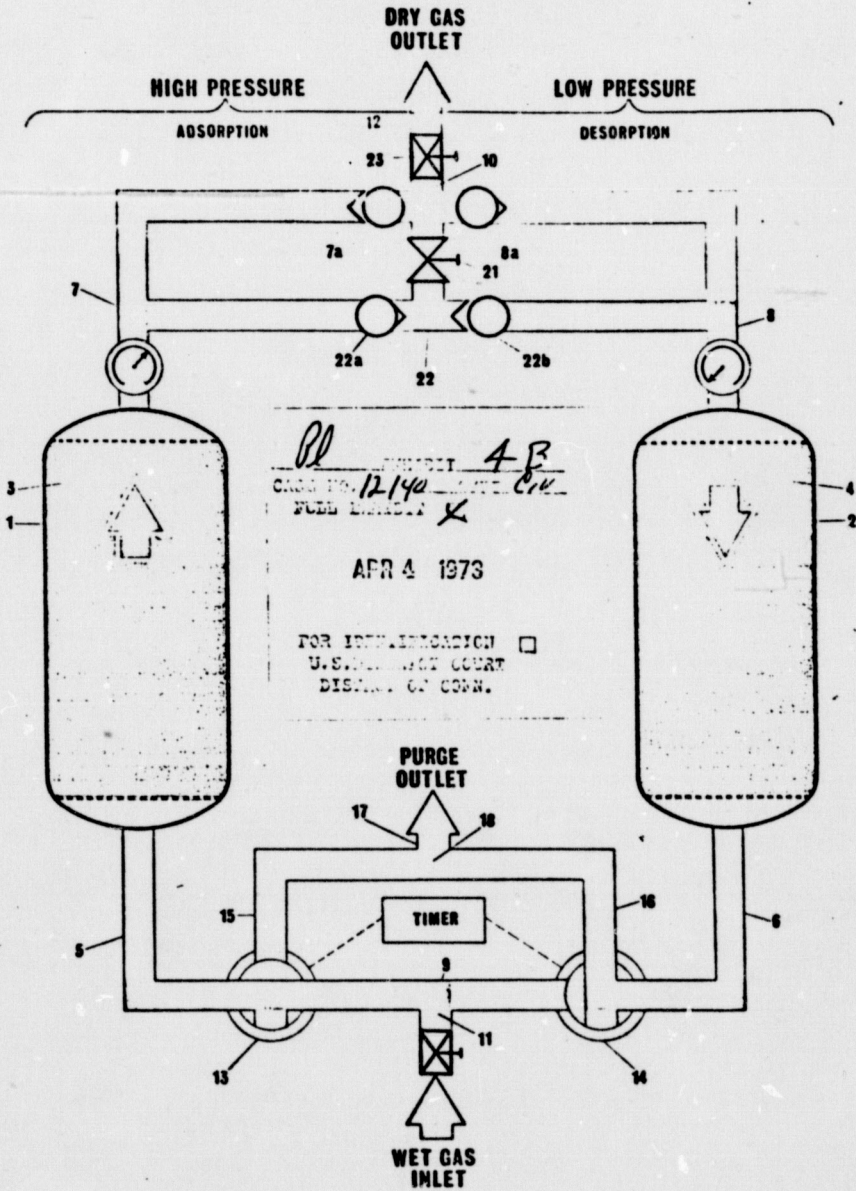
M. JOSEPH BLUMENFELD
United States District Judge

FIRST CYCLE PERIOD



63a

SECOND CYCLE PERIOD



Judgment

UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF CONNECTICUT

Civil Action File No. 12,140

ESSO RESEARCH & ENGINEERING COMPANY,

—v.—

KAHN & COMPANY, INC. and CHANDLER-EVANS, INC.

This action came on for trial before the Court, Honorable M. JOSEPH BLUMENFELD, United States District Judge, presiding, and the issues having been duly tried and a decision having been duly rendered, under date of April 30, 1974

It is Ordered and Adjudged that U. S. Letters Patent No. 2,944,627 be and is hereby declared invalid and that this action be and is hereby dismissed, with costs to the defendants.

Dated at New Haven, Connecticut, this 2nd day of May, 1974.

SYLVESTER A. MARKOWSKI

Clerk of Court

By: FRANCIS J. [Illegible]

Deputy in Charge

Notice of Appeal

UNITED STATES DISTRICT COURT

DISTRICT OF CONNECTICUT

Civil No. 12,140

ESSO RESEARCH & ENGINEERING COMPANY,
Plaintiff,

—v.—

KAHN & COMPANY, INC. and CHANDLER-EVANS, INC.,
Defendants.

Notice is hereby given that ESSO RESEARCH & ENGINEERING COMPANY, plaintiff above named, hereby appeals to the United States Court of Appeals for the Second Circuit from the final judgment entered in this action on May 2, 1974.

ROBINSON, ROBINSON & COLE

By BRUCE W. MANTERNACH

799 Main Street

Hartford, Connecticut 06103

Attorneys for Plaintiff

May 28, 1974

[Affidavit of Service omitted in printing.]

EXCERPTS OF TESTIMONY

* * * * *

[3] The Court: Good morning, gentlemen.
Does anybody want to begin?

Mr. Huettner: May it please the Court. My name is Richard Huettner. I'm the attorney for the plaintiff, Esso Research & Engineering Corporation.

Before I commence, your Honor, may I introduce the people that are with me in connection with this matter.

The Court: That would be very nice. Go ahead.

Mr. Huettner: Sitting at the table on the left here, the first gentleman is Mr. Robert I. Pearlman. Mr. Pearlman is an attorney with the Esso Research & Engineering Licensing and Patent Department.

The Court: House counsel.

Mr. Huettner: He is house counsel, yes, your Honor.

The Court: All right.

Mr. Huettner: Sitting next to Mr. Pearlman is John P. Kirby, Jr. Mr. Kirby is an associate of mine from our law firm.

The Court: All right.

Mr. Huettner: Sitting in the first row behind the bar, your Honor, is, first on the right, Dr. [4] Meissner. He will be the first witness.

The Court: All right.

Mr. Huettner: Sitting next to Dr. Meissner is Dr. Charles W. Skarstrom, who is—

The Court: The inventor.

Mr. Huettner: He is the inventor. He was formerly an engineer with Esso and he is now retired.

Colloquy

In the second row is Mr. Manino. Mr. Manino is a technician with the Pall Trinity Corporation, your Honor, and his only function is to assist us in making sure that a model that we have here operates properly. He knows how to operate them.

The Court: All right.

Mr. Huettner: Your Honor, may I make a very short opening concerning the subject matter of this litigation?

The Court: I would appreciate it.

Mr. Huettner: This is a patent lawsuit, your Honor. It involves a process or a method patent which initially had an application filed in February of 1958. The patent, itself, issued in July or on July 12th, 1960.

The patent, as it states on its title, is for a method and apparatus for fractionating gaseous mixtures by adsorption.

[5] The claims in suit, your Honor, relate to the method involved in the invention. So that we are concerned with the process. It is, therefore, a process of fractionating gaseous mixtures.

By fractionating, your Honor, we mean separating, breaking down. You fraction a gas; you take out one of the ingredients of a number of gases in a mixture. This is done by a process of adsorption.

So we are removing one kind of gas from a mixture of gases by adsorption. We are not, your Honor, in this case, concerned with liquids, like water, where you use a sponge and absorb. We are talking about gases, removing one gas out of a mixture of gases.

Colloquy

Now, among the gases that we are going to be primarily interested in is water vapor. That is a gas as used in this patent; water vapor. That is part of the air that we are breathing.

This morning I heard that there was 89 per cent humidity in the air. That is a measure of water content in the air.

Actually, at the temperature of this morning, which was about 45 degrees, a humidity reading of 89 per cent meant that the air surrounding us contained 1 per cent water vapor. In addition, air [6] contains many other gases, such as approximately 20 per cent oxygen and 79 per cent nitrogen.

There are minute other ingredients, carbon dioxide, and many others. But the air we have here is a gaseous mixture which contains water vapor and that is a gas.

This invention relates to the removal of one of the gases out of a mixture and we use as an example in the patent and in our discussion, because that is what it is primarily used for in industry, the removal of water vapor out of air. And this is done by adsorption, your Honor.

It is not done by drying it in a drier; it is not done by freezing and condensing the water into crystals and having them fall out. It is done by adsorption. Now that, your Honor, is the process which is involved when a gas is attracted by a solid and the gas is separated out because of the affinity of the particular solid to attract that particular gas.

There are adsorbents that have affinities for oxygen that will tend to withdraw oxygen while not disturbing

Colloquy

other gases in the mixture. There are adsorbents that have an affinity for water vapors and will attract the water vapors without attracting, [7] to any substantial degree, the remaining gases.

The adsorbents that attract water vapor are frequently called desiccants. And one, in his every day life, has experienced or seen these desiccants. Sometimes in pill bottles one finds a little cartridge which you are supposed to leave in there until you use the pills, and then you throw that out. That little capsule contains a desiccant. It is in that pill bottle to keep the moisture in the pill bottle down, and so it doesn't react with the pills or the vitamins, or what have you.

Desiccants are also used in refrigerators. Desiccants are, as I mentioned, for water.

Adsorbents is a general term. Adsorbents can be used and you find them very frequently for removing odors. They adsorb a particular gas; the solid pulls in and holds the gas.

Now, pretty soon these adsorbents reach a certain point where they can no longer hold any more of the particular gas for which they have an affinity. They become saturated. And even if there is more moisture in the air, if the adsorbent has become saturated it cannot hold that moisture and, as a result, it loses its effect.

[8] Now, you can do one of several things. You can throw out the adsorbent and replace it with a new one that is dry, that has the capability of holding whatever gas you are trying to get; or you can regenerate, as the term is used, or dry out the adsorbent. In other

Colloquy

words, regenerate it back to the condition that it was when you first started to use it and make it available to adsorb whatever gas you are trying to collect.

Now, regeneration is a very important factor because you save the adsorbent and you can reuse it again and again. So regeneration can be accomplished by various ways.

The most common way of regenerating an adsorbent or putting it back into its condition where it can be used to adsorb is to heat it. In so doing you are able to drive out the water that has been collected on the adsorbent.

There are other ways of regenerating, such as using a dry stream of washing gas, or purge gas, as it is called; it is purging, it is washing out whatever you want to get rid of.

So if you use a very dry gas it can pick up that water, or whatever you have collected, and wash it out, purge it out, and thus put back your [9] adsorbent into a condition to be reused.

The patent in suit, your Honor, is very unique in that it uses as a washing gas, or a purge gas, some of the product or dry gas that it originally produced. In other words, what it is doing is producing dry gas; that is, dry air, air without any moisture. That is the function of the adsorbent.

But for desorbing it is taking some of that which it has already produced and in a very unique manner is able to dry out the bed after it has gone through a cycle of adsorption. It takes some of the product and dries out the bed so it is ready to go through the cycle again.

Colloquy

What is interesting, your Honor, it only takes off a very small amount of the product, so that you do have a large quantity of the product from adsorption. It takes off a small part of that product, which is sufficient to desorb, so that you can start the cycle all over again. It seems like it is almost perpetual. As a matter of fact, some of these driers have been in existence for twelve years without stopping. They just go.

They are what is called completely self contained, your Honor. They do not use any outside power to desorb. They do not use electrical heat [10] or any other kind of energy to desorb, to dry out the bed to make it ready for its adsorption again. The patent in suit does not use any outside power.

The Court: All except for pressure forcing the gas?

Mr. Huettner: Yes, your Honor. We will come to that, the particular operation.

And why does all this take place? It's a self contained unit. It regenerates itself without using outside power. This is done, your Honor, by using a feed gas which is under pressure.

The feed gas, if it is air, is like the feed gas that you go into a garage and the pressure in a garage usually varies probably between 75 and 100 pounds, depending on the compressor that they have at the garage. But they have one there and it builds up into a tank. That kind of pressure is common in industry. Industry has air pressure all over its plant. Laboratories always have compressed air pipes as well as electrical conduits. It is common to have compressed air. That is almost a part of building a commercial operation today, to have compressed air available.

Colloquy

The compressed air, your Honor, is what is fed into the patent in suit drier. On adsorption [11] the air is under compression. It passes through the adsorber under pressure and goes out dry through an exit line still under pressure.

A small quantity of that product can be withdrawn and reduced to atmospheric pressure, which when you reduce air it expands. And by taking a small amount of the product that is dry you can recirculate that down through your wet bed and desorb it, or dry it out, and make it ready for adsorption again.

It must be noted that there is counter current flow. In all our examples, your Honor, we will say adsorption takes place from the bottom of a bed upwardly. All examples are that way, your Honor.

In other words, we get in the wet gas and as it goes through the bed, which is a chamber, it is like a cylinder, it becomes drier and drier, and then when it reaches the top of the bed it is dry and it passes out as product gas. It is dry at the top.

We take a small quantity of the dry air from the top and pass it down into a complementary bed from top to bottom, pushing down and desorbing from top to bottom, counter current flow.

Adsorption, that means drying out the air. [12] When you desorb you dry out the bed from top to bottom.

In addition to the counter current flow it is essential in the patent in suit that the time permitted for a bed to be on adsorption be short, short cycle time. In other words, the process of adsorbing and desorbing

Colloquy

is very short. The patent describes minutes, two or three minutes, down to seconds.

In other words, you don't fill up the whole bed. What you do, you adsorb a very short time, you flip over and you desorb. Adsorb, desorb; adsorb, desorb—rather than letting it run for hours, as were the previous driers. They would adsorb for hours and fill up the bed, and then they would desorb with the use of heaters and large amounts of purge gas.

But the present invention doesn't do that, your Honor. It doesn't give the bed a chance to change where the adsorption takes place. It is in a relatively short area. Adsorption only occupies a small amount of the bed.

Now, why is that critical? That is critical because we have in adsorption—and we will show you this, your Honor—what is called the heat of [13] adsorption. During adsorption, when the moisture in air contacts the solid particles, heat is generated. And we will let you find that out by just putting your finger in some beads to which water will be added and you will see that they get warm.

The Court: On adsorption?

Mr. Huettner: On adsorption heat is generated.

On desorption you must use heat to dry out the bed. Desorption needs heat. Adsorption generates heat.

With the short on-off, or short cycle action of the patent in suit, the heat generated by adsorption, because it is such a short cycle, a minute or two minutes, is used then immediately to desorb. It is not lost. It stays within the bed. It stays at the birth place where it was created. It is not dissipated.

Colloquy

And in order to desorb one must have that heat. And he can't let it vanish. But by using short cycles the heat generated by adsorption is sufficient to desorb on the complementary cycle.

So you adsorb for three minutes, desorb for three minutes; adsorb for three minutes, desorb; always retaining the heat within the adsorbent bed and not letting it get lost.

[14] Your Honor, there are just a few other points I would like to mention.

The Court: While we are on this one, you say the heat isn't lost, it doesn't build up further. It is used for the desorption?

Mr. Huettner: The drying out, the desorption, yes.

The Court: So it remains more or less constant?

Mr. Huettner: Yes, more or less constant, your Honor. That is correct.

It will not have a chance to pass up through the bed, which is a tower, and go out in the product, get lost in the product, carry through, because the cycle is so short.

The Court: It is used before it is dissipated?

Mr. Huettner: That is correct.

There is no radiation of the heat. It doesn't go out the side of the cylinder.

The Court: How is it made use of in the desorption?

Mr. Huettner: Your Honor, that is a chemical—

The Court: As a heat exchange?

Mr. Huettner: Yes. It is a heat exchange. For desorption to take place you need heat.

Herman P. Meissner—for Plaintiff—Direct

[15] Your Honor, when one dries himself off he loses heat. But in a steam bath, where you are giving up heat, you are warm. Now, you need heat to give up water in a steam bath. You are giving out the water.

In desorption the adsorber, the little particles, are giving out the water because they are being readied, they are being cleansed out. So they are giving up the water that they had acquired. In order to give up water they are giving up the heat.

So the heat that they have to give up in order to desorb, in order to give up the water it needs heat, and that is the heat we are talking about. That heat happens to be the heat that was created on adsorption.

The Court: All right.

Mr. Huettner: And I hope our expert will give you a better explanation of it than I can, your Honor.

I am now going to leave the invention for just a minute. The patent itself, your Honor, I think is technical. Like most patents that your Honor has probably been faced with, patent attorneys seem to have an ability to write so that nobody

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[24] Mr. Huettner: My first witness, your Honor, will be Herman Paul Meissner.

HERMAN PAUL MEISSNER, called as a witness, being first duly sworn, was examined, and testified as follows:

The Clerk: Please be seated and will you state your address for the Court?

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The Witness: I live at 28 Samoset Road, Winchester.

The Clerk: Would you spell that?

The Witness: S-a-m-o-s-e-t, Winchester, Massachusetts 01890.

Mr. Huettner: I would like to introduce as Plaintiff's Exhibit 1 the soft copy of United States Letters Patent 2,944,627, which is the patent in suit.

Your Honor, I have provided you with a copy of that patent during my opening.

The Court: Yes.

Now, this list of proposed exhibits also is numerical as is—I see. The defendants' are alphabetical.

Very well. That will be Exhibit No. 1.

(Plaintiff's Exhibit 1: U.S. Letters Patent [25] 2,944,627, marked full exhibit.)

Mr. Huettner: I would like to introduce as a separate exhibit, your Honor, so that it is available, the Figure 1, which is the drawing that appears on the first page of the patent. I would like to have that marked separately so that your Honor doesn't have to flip back and forth when we discuss the patent and the drawing.

The Court: Very well. Exhibit 2.

(Plaintiff's Exhibit 2: Figure 1 of Patent 2,944,627, marked full exhibit.)

Mr. Huettner: I am putting, your Honor, a marking of P2 on a large blowup which we have made of the

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patent drawing so that the witness may point to it when necessary to assist the Court in showing exactly where some of these numbers are hiding.

The Court: All right.

Direct Examination by Mr. Huettner:

Q. Dr. Meissner, how old are you? A. I'm 65.

Q. What is your present position, Dr. Meissner? A. I'm the DuPont Professor of Chemical Engineering at the Massachusetts Institute of Technology.

Q. Dr. Meissner, where did you obtain your formal education? [26] A. I received a Bachelor's degree in chemical engineering in 1929, incidentally, at the Massachusetts Institute of Technology. I received a Master's degree in chemical engineering in the same institution in 1930.

I got a Doctor's degree in physical chemistry at the University of Frankfurt-am-Main in Germany in 1938. I spent from 1937 to 1938, approximately two years, in Germany. In addition, I suppose I might add that I stayed for another year in the period of from 1932 to 1933 at the Massachusetts Institute of Technology on a Sloan fellowship so-called, in which I studied business administration.

Q. Is that the Sloan fellowship that is still in existence today? A. Yes, sir.

Q. Dr. Meissner, you say you got your doctorate in Germany? A. Yes, sir.

Q. Can you tell me was your examination in German? A. It was.

Q. Was your oral examination in German? A. It was, sir.

Q. Was the written in German? A. Yes, sir, it was.

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Q. Do you consider yourself fluent in technical German?

A. I do.

[27] Q. Between the time of the Sloan fellowship, which was 1932 to 1933, and your doctorate, what did you do with your time? A. I was continuously employed. As a matter of fact, from 1930 upon receiving a Master's degree, from that time till I went to Germany to do some doctorate work I was continuously employed with the Commercial Solvents Corporation in New York City as a technical assistant to the Vice-President in Charge of Research and Development. I received a leave of absence from that company in order to take advantage of the Sloan fellowship which I mentioned earlier.

Q. After your doctorate what did you do, Dr. Meissner?

A. Upon returning to this country I joined the teaching staff of the Chemical Engineering Department at MIT and have been there ever since.

Q. Continuously? A. Continuously, yes sir. Interrupted only, of course, by short periods during summers on consulting work of various varieties.

Q. You are a full professor? A. I am, sir. I have been a full professor for the past roughly a little over twenty years.

Q. During that past twenty years, Dr. Meissner, can you tell me have you taught any courses relating to the subject matter of the patent in suit? [28] A. After all, chemical engineering has as one of its difficult problems the separation of mixtures. The courses that we teach, courses in the field of, for example, unit operations, which I have taught, deal extensively with the problems, with the procedures for separating mixtures of all sorts. This includes, of

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course, gaseous mixtures as well as liquid mixtures and the like.

In addition, I have taught courses, I do teach courses in the field of surface chemistry. Adsorption, as we define it at the Institute, falls into the field of surface chemistry.

Q. Dr. Meissner, are you a member of any scientific societies that are of any note for this litigation? A. I am a member of the American Chemical Society and, of course, have been for years; a member of the American Institute of Chemical Engineers; a member of the Institute of American Metallurgical Engineers.

Q. Have you been elected to any honorary societies or associations? A. I am a member of the American Academy of Arts and Sciences. I'm also a member of Sigma Psi, which is a research fraternity.

Q. Have you any publications under your name, Dr. Meissner? A. I have counted them the other day. I have about [29] fifty publications in review journals, technical publications therefor. In addition, I do happen to have some patents. I probably have twelve patents—it's about twelve—United States patents. There are, of course, foreign equivalents thereof.

Q. Dr. Meissner, while a member of the staff of MIT have you done any consulting work? A. Very extensively. I have consulted since 1938.

Q. Can you tell me in what fields you have consulted or some of your employers that have any relation to the subject matter of this litigation? A. Yes. I have consulted during this period of time for a number of companies. A good part of this consulting work has been with Arthur D. Little, Incorporated of Cambridge, Mass. I have con-

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sulted continuously for that company since 1940 to the present time.

Arthur D. Little, Incorporated is a consulting company headquartering in Cambridge. It is a large show. It has perhaps a thousand professional employees and is active in the broad field of engineering and science.

I have consulted for them in a great number of the problems that they have encountered. These problems in which I have consulted have been process problems. My primary field is industrial chemistry. I think I have, therefore, all the time faced problems that deal with the separation of mixtures.

[30] Q. What are some of the other companies, in addition to Arthur D. Little, that you have consulted for? A. Well, I have and am consulting and have consulted for DuPont, for Stouffer Chemical, for IGT—that's the Institute of Gas Technology, which incidentally at the present time is so deeply concerned with the problem of making synthetic natural gas. It is in the process of making that synthetic gas, of unscrambling, of separating some of those gas components that come from coal gasification to produce pure natural gas that I'm active.

I might mention that in addition, of course, while with the Commercial Solvents Corporation I have—with Arthur D. Little I have consulted for a number of other companies; for example, in the metallurgical field, in the pharmaceutical field, in the chemical field and so on.

And I would be glad to go into details, if that is of any interest.

Q. No, I don't think we have to go into all of these.

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Have you had any experience with water separation, Dr. Meissner? A. Yes. Water separation is a problem which is faced up to frequently in the field of industrial chemistry and I have had to deal with those problems.

For example, in the manufacture of sulfuric acid, which is a very common and important industrial chemical, the [31] air which is used for the combustion of sulfur in making that acid must first be carefully dried. It happens to be dried not by adsorption, but by sulfuric acid.

I have had, of course, a great deal to do with the design of sulfuric acid plants and, therefore, with the design of drying systems for the air used therein.

Similarly in the manufacture of iron today in the blast furnace it is important and advantageous to supply the enormous quantities of air required by blast furnaces in dry form. The drying of that air is by condensation, by procedures that are not uncommon to the usual air conditioning field.

And I have been actively involved in the design and inspection of such systems technically.

Again—well, perhaps that's enough of a set of examples.

Q. Dr. Meissner, have you been retained by Esso Research & Engineering as an expert for this litigation against Kahn & Company? A. I have been.

Q. Have you ever had any previous consultation work with Esso or Esso Research & Engineering? A. I have never consulted for Esso.

Q. Dr. Meissner, are you familiar with a Dr. Edwin Gilliland? [32] A. I am. He was a very close associate of mine and a dear friend. His office was next to mine at MIT.

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Q. And when were you retained by Esso in relation to this particular matter? A. Sometime in the early part of January.

Q. And prior to that had you any discussions with Dr. Gilliland? A. Not prior to that time.

Q. After that time? A. Afterwards, repeatedly.

Q. And why did you have discussions with Dr. Gilliland? A. Dr. Gilliland had become ill. I believe that Dr. Gilliland had been originally scheduled to act as an expert in this case. But Dr. Gilliland became ill and felt that he could not face up to extended activities. He, therefore, retired from the case and amongst other people I was considered as being qualified for taking over as expert.

When it turned out that I was to be active, why, Dr. Gilliland spent a considerable amount of time with me giving me the benefit of his thinking.

Q. And did you state whether Dr. Gilliland was still alive? A. Dr. Gilliland, unfortunately, died three weeks ago, very suddenly.

Q. Dr. Meissner, have you read the Skarstrom patent in [33] suit, which is United States Letters Patent 2,944,627? A. I have.

Q. Dr. Meissner, do you feel comfortable with the subject matter of that patent? A. I do indeed.

Mr. Huettnner: Your Honor, I would like to request that this Court recognize Dr. Meissner as an expert.

The Court: Very well. He's qualified.

By Mr. Huettnner:

Q. Dr. Meissner, do you have the patent in suit before you? A. Yes, sir.

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Q. Which has been marked Exhibit T-1? A. Yes, sir.

Q. Dr. Meissner, to what does the patent in suit pertain?

A. As indicated by its title, "Method and Apparatus For Fractionating Gaseous Mixtures by Adsorption."

Perhaps the first two sentences in the patent are helpful also:

"This invention relates to a method and apparatus for fractionating gaseous mixtures. The invention relates, more particularly, to a method and apparatus for removing one or more key components from a gaseous mixture or gas

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[42] speak in terms of volume per cents or in terms which are equivalent to volume per cent.

A volume per cent might be visualized as follows. First imagine, remember again the imaginary experiment that we carried out before; the two bottles of gases that were brought together mouth to mouth and allowed to mingle. The bottle of oxygen plus the bottle of nitrogen.

If those two bottles had initially an equal volume, each has the same volume as the other, and if the temperature and pressures are identical in the two bottles, then when we bring them together and allow the gases to mingle the resultant mixture is a 50 per cent mixture. We have allowed one volume of oxygen and one volume of nitrogen to come together and mingle at constant temperature and pressure, and the result has been a 50 per cent mixture of oxygen and nitrogen.

So that in the case of air, dry air has a composition of about 79 per cent nitrogen, 21 per cent oxygen. Such a

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mixture I could visualize as preparing by bringing together two bottles of appropriately different sizes, one having 79 parts by volume, the other 21 parts by volume, and allowing the contents of the two bottles to mix at constant temperature and pressure.

Q. Is there another way that is used to measure composition of gas mixtures? A. Throughout this material—

[43] Q. What is "this material," Doctor? A. These patents, we will find that water content of air is designated in terms of parts per million.

For example, the air in this room is probably running somewhere around 1 per cent by volume water vapor. Therefore, if you please, 10,000 parts per million. One per cent corresponds to 10,000 parts per million.

Q. In other words, if you are 10,000 over one million you equal 1 per cent? A. Yes, sir.

Q. So you can correlate the two? A. Or you could put it in hundreds.

So that parts per million are used as a convenient expression for volume per cent. Because when we talk about very dry air, indeed the volume per cent becomes so small that it is an inconvenient kind of measure to use and parts per million gives us a more reasonable number to deal with. Instead of an extended decimal, why, it's a finite number.

Q. Now, the air in this room, you would just guess at 1 per cent? A. I would guess.

Q. Water vapor? A. Today, yes, sir.

Q. Would have how many parts per million? A. Ten thousand parts per million.

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Herman P. Meissner—for Plaintiff—Direct

[48] get you in on the main line.

Mr. Huettner: We have asked Dr. Meissner to expedite and we hope we can in what follows.

The Court: Very good.

By Mr. Huettner:

Q. Dr. Meissner, can you tell me how the volume of gas varies with pressure? A. Volumes of gases vary inversely with the pressure and indeed with the absolute pressure, not with the gauge pressure. So that volumes are inversely with absolute pressure, always thinking in terms of constant temperature.

Q. Dr. Meissner, in the patent in suit there is mention of the term "partial pressure."

And, your Honor, this is a very difficult one and I hope we can get through it, but it is one that we will have to explain.

The Court: All right.

Mr. Huettner: It is not really what you and I initially would think it to be.

Q. Would you explain to the Court what is meant by partial pressure as used in the patent in suit? A. The concept of total pressure on a gas, on a pure or a mixed gas, we've talked about and is clear as is illustrated by the little experiment with the pump, compressor. Given a mixture instead of a pure gas it stands to reason that

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[58] A. No sir, they are not. Each adsorbent shows a particular inclination to adsorb some particular material.

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For example, a hydrocarbon like methane or ethane is better adsorbed on active carbon than it is on alumina.

On the other hand, alumina is a better adsorbent for water than is carbon, active carbon.

Q. So one selects an adsorbent for the particular job one wishes to accomplish? A. Precisely, yes sir.

Q. Are the adsorbents old and known in the art, Dr. Meissner? A. Yes, sir.

Q. And their physical properties are also well known? A. Well known and well understood.

Q. Now, Dr. Meissner, would you explain what happens when an adsorbent as we have here, aluminum— A. Alumina.

Q. —adsorbs water vapor? A. When an adsorbent such as alumina adsorbs water vapor the water vapor diffuses through the wet gas. And by the term "wet gas," of course, is meant gas containing a significant partial pressure of water vapor, containing a significant amount of water vapor.

When wet gas passes over or through an adsorbent—and by adsorbent can be understood a bed of granules of this [59] sort—then the water vapor contained in the wet gas finds its way to the granules by diffusion and/or by direct contact because of the passage of gas, for example, through the bed of adsorbent.

The water vapor upon contacting the granules finds its way into the pores of the granules by diffusion and combines with the contiguous adsorbent surface. It stays there.

The water vapor then is removed from the gas phase by the adsorbent surface.

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Q. When this happens, Dr. Meissner, is there any temperature relationship? A. There is, indeed.

The process of adsorption is always associated with a heat effect. And, indeed, if water vapor is being removed by an adsorbent, that is to say if adsorption is occurring, then heat is evolved.

If, on the other hand, instead of adsorption, if desorption were to occur, that is to say if water vapor instead of being added to an adsorbent surface were removed from that adsorbent surface by any manner, such as by evacuation or otherwise, then instead of having a heat evolution there would be a requirement of heat. That is to say, the heat evolved when, let us say, one pound of water is adsorbed on an adsorbent surface. When that pound of water is desorbed from that surface, exactly the same quantity of heat must be

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[63] be noted that the gases pass up through this bed, being in the vessel here on the right of this exhibit, it passes up through it in what we call piston flow. That is to say, the gas passes up through the bed of granules with, hopefully, equal velocity at all points across the bed, so that any imaginary advancing front of gas here remains horizontal and so on. So we establish piston flow in a system like this.

In consequence of such a flow, when wet gas enters bed No. 2 through the conduit down here, which is labeled No. 6—

Q. We will get to that, Dr. Meissner.

Herman P. Meissner—for Plaintiff—Direct

By the Court:

Q. What happens when it passes through, was the question. A. The wet gas, when it first contacts the initially dry bed, let us assume that we have placed dry material in here, surrenders its water to the first layer of granules that it touches.

After all, as it comes up through here it reaches the first layer of granules and surrenders water to that. In consequence now, then, the bottom layer of granules, of course in picking up water, those granules become increasingly wet. They pick up more moisture.

As a result of passing that first layer of granules, then, the gas traveling vertically upward has become dryer because it has surrendered some water to the granules that it [64] has just seen. It then passes to the next layer of granules which are still dry. They, in turn, pick up water from this partially dry gas within the space of very few granules. Indeed, the gas has surrendered the water that it initially carried, the water vapor that it initially carried to the adsorbent and the adsorbent in the bottom part of the bed has now become very wet. But as the gas travels in the higher reaches of the bed, the adsorbent in these upper reaches of the bed remains dry. It has not had a chance to pick up any water vapor.

Now, as gas flow continues the gas then passing up through this vessel in going through the bottom layers of the bed that are dry, the bed adsorbent that is dry, the gas surrenders then increasingly its moisture, travels up through the top reaches of the bed where the adsorbent is dry and emerges then here in a completely dry condition.

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So we have this kind of a picture. We have the wet gas down here, dry gas up here, flowing continuously through the bed. Whilst that proceeds there is a zone, and for convenience a reaction zone, let us call it a reaction zone, where the exchange of water vapor is occurring between the flowing gas and the dry solids which it overtakes.

At any time in the process, therefore, this bed looks as follows: There is a top region in which the solids are dry, an intermediate region somewhere which we might call [65] the reaction zone in which there is a change in the concentration of water vapor, or perhaps I should say there is a change in the amount of water carried by the dry adsorbents. Then finally we get to a zone of solids in the bottom of that bed in which the solids carry the maximum amount of water that they can carry whilst being in contact with the gas flowing through there.

By Mr. Huettner:

Q. Now, Dr. Meissner, if one continues the feeding of wet gas into the adsorbent vessel what happens to the adsorbent in that vessel? A. If the feeding of wet gas continues, then of course the reaction zone, so-called, continues to move up in the column until finally the complete bed has been satisfied; that is to say, it has been saturated with water vapor. And as a result of that all parts of the bed now exist in equilibrium as it were with the wet feed gas entering the bottom of the reaction zone.

Q. Dr. Meissner, is there any thermal reaction taking place as this gas is fed into the adsorbent vessel? A. Simultaneously with the adsorption occurring there is, of

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course, the heat effect. That is to say, heat is evolved during adsorption always.

So that in the reaction zone, which is moving up through this bed as a result of the wet gas entering down [66] below, in that reaction zone heat is generated continuously. Every time a molecule of water is adsorbed a corresponding amount of heat is generated.

It should be noted, of course, that in adsorption the location, the place where heat is generated is right on the surface of the adsorbent. It is not generated within the gas phase, nor deep within the substance of the solid. It is generated on the surface of the adsorbent.

Q. As the feed is maintained or continued, what happens to the temperature reaction? A. Well, as feed continues the reaction zone increases in temperature and tends to increase in temperature some as gas flow continues.

Since, however, there is gas flowing through this reaction zone at all times the flowing gas, in turn, becomes heated; it becomes warmed. After all, if gas flows through any hot solid it will pick up some of the temperature, some of the heat in that solid and tend to cool the solid and itself increase in temperature.

So we have then two operations going on here. As the gas passes through the reaction zone it picks up some of the heat and increases in temperature. Immediately upon leaving the reaction zone, in the higher reaches of the bed, why, it surrenders some of that heat again to the dry solid which lies above the reaction zone.

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[67] *By the Court:*

Q. It gets warm and then cools off? A. Yes, sir. In other words, the reason why it gets warm is because heat is generated in this reaction zone. But then when the gas passes out of the reaction zone it is now in contact with solids which are no longer generating heat because, you see, there is no moisture being picked up in that region. And so the gas cools off again.

Now then, unlike the moisture which has been adsorbed, once moisture is adsorbed by an adsorbent it stays in place; it does not travel. It stays there in an adsorption step in a cycle like this.

On the other hand, the heat which is generated is not so immobilized. It travels. It travels in this sense: That the heat of adsorption, as we have just seen, flows into the gas passing through the bed and heats the gas. The hot gas then travels up into the bed and surrenders its heat to the surrounding solids.

This process is, of course, cumulative so that it is clear that as time passes the heat passes very quickly further and further into the upper reaches of the bed and shortly a condition is reached wherein the heat generated in adsorption is carried out of the bed by the gas itself. Because the gas no longer can surrender the heat that it is carrying, the temperature that it is carrying, to the top [68] parts of the bed because they, in turn, have become warmed, you see.

So we find that the gas emerging from the top part of the bed is now no longer at the entrance temperature, but has been heated hot. I say "hot"; has reached a higher temperature.

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By Mr. Huettner:

Q. If such a condition exists where you have maintained the feed for a long period of time, can other losses of heat be apparent? A. Yes, they can.

The focus in this discussion perhaps has been too much on the heat carrying phenomenon as associated with gas flow. There is simultaneously, of course, other means of transporting heat.

For example, as this bed gets hotter and hotter, that is to say as its temperature increases, I should say as the reaction zone increases in temperature, as it gets hotter because of the cumulative effect of adsorption in the reaction zone region, why, then of course there is some temperature difference between the bed itself now and the surroundings. So that there can be heat loss by conduction and convection to the surroundings.

In addition, there is also heat loss from the reaction zone in the bed; not only because of the action of the [69] gas, which you will remember is heated and then cooled, but in addition there is some heat loss because of the fact that the grains, the colder grains of the bed in the upper reaches are in contact with the relatively hot grains in the reaction zone. If the reaction zone is hot, you remember up above the reaction zone where no adsorption is occurring the bed is cooler.

So we have then a region in the bed in which there are granules at one temperature, at a higher temperature, in contact with granules at a lower temperature.

Inevitably just because of the solid contact, it's like, I suppose, putting a marble on a hot stove. Although I certainly greatly exaggerated there the temperature differ-

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ences, there will be slow flow from the hot stove surface to the marble surface.

Now, we are not talking about a flat surface here. We are talking about grains of adsorbents in contact with each other. There is travel, some travel of heat out of the reaction zone due to the conduction of the solid particles, due to the fact that they are in contact with each other and the solid particles in the upper reaches of the bed are correlative to the granules within the reaction zone.

This conduction process, however, is really not very important in this sense. It is important in another sense, but heat does not travel very well by conduction in granular [70] solids because a bed of granular solids like this is really a good insulator.

Refrigerators, for example, that we have in the home, domestic refrigerators are insulated in good part today by beds of granular solids. Now, the granular solids are not expensive adsorbents. They do not have this enormous internal surface that our material here has. But otherwise are not too different than the kind of solids that we are talking about.

Those beds are good insulators. Heat does flow some by conduction through those things. But it is not a very rapid flow.

Q. Now, Dr. Meissner, what is the significance of the heat being passed up into the bed, out of the bed or through the sides of the bed? A. The significance has to do particularly with the restoration process. That is to say, the regeneration of one of these beds.

In adsorption a certain amount of heat is evolved. In desorption—and the term, of course, when I say desorption,

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that means water vapor out of the gas, out of the solid into the gas. In desorption heat must be supplied.

So that the bed carries on its own accounting. Once a reaction zone has traveled up through a bed of this sort and adsorbed water vapor and at least some of that heat [71] has moved up into the top parts of the bed, then upon the return cycle, when this bed is regenerated, means must be supplied for restoring that heat to, what shall I say, to the birth place, to the place where it started from.

It has got to be exactly from where it started from and on the same surfaces. If it doesn't get there the process won't work, the operation won't work on a continuous basis.

Q. That's the Skarstrom? A. That's the Skarstrom.

Q. Now would you explain what happens when I said but when heat is dissipated through the top, through the sides or into the top of the bed what significance is that, Dr. Meissner? A. Well, if the heat is dissipated through the top of the bed, as for example by having hot gases, gases at higher temperature leave the top of the bed, or if it is dissipated through the walls of the bed to the surroundings, then that heat must be restored somehow or other. Heat must be restored to this reaction zone in the return cycle, in the regenerating cycle.

By the Court:

Q. But you have to get heat in there if you are going to regenerate? A. Yes, sir.

Q. And you want to save this heat that you have already generated, is that it? [72] A. Yes. And the technique that has been used in the past for restoring that heat, for obtain-

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ing it, of course, has been by either immersing hot surfaces in that bed so that the heat can be generated in situ; electrical resistance, for example, electrically heated plates.

Q. Provide heat from another source? A. Yes, sir. Or else the heat can be provided by, as we will see, reheating gas that has passed down through this bed, feeding it with hot gases.

Q. Well, you've got hot air, hot gas going out there and it doesn't need to be hot because it is already dried, right? You've got dry gas going out there? A. Yes, sir.

Q. And it is hot? A. Yes, sir.

Q. And you want to save that heat? A. Yes.

Q. You want to use it? A. Yes, sir.

Q. To regenerate the beds? A. Yes, sir.

Q. Is that right? A. That is correct.

Q. That's the theory of this system? A. Yes, sir. And it doesn't have to be that heat.

[73] Q. I understand. A. Heat from any source.

Q. But if you've got it there and you don't have to dissipate it, you can use it, that's one place you can use it, right? A. Yes, your Honor.

Q. Is that what happens? A. Well, now in the Skarstrom heaterless drier operations are carried out in such a way that the heat generated in the adsorption is conserved in such a way that it can be reused.

Q. All right. A. Prior to the Skarstrom invention—

Q. No. We are talking about this one now. We are not talking about how good it is or how unique it is. A. That is correct, then. It is that heat which is concerned.

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Q. We are talking about how you are trying to show me how it works. Then we will get into whether you ought to have a patent on it. A. All right, sir.

Q. Now, we got to the point where we got the heat going out with the dry air. And you say this system uses that heat, the part that doesn't escape through the side walls?

A. In talking then about the Skarstrom heaterless drier—

[74] The Court: Wait a minute. Maybe we ought to put ourselves in the hands of counsel again.

By Mr. Huettner:

Q. Would you want to sit down, Dr. Meissner, and stay away from Figure 1 and maybe we will eliminate the confusion. A. All right, sir.

Q. Have you been describing the operation of the Skarstrom invention or have you been describing the reaction that takes place in vessels having adsorbents in general?

A. The latter. I've been describing the processes that take place in vessels containing an adsorbent.

Q. In general? A. In general, yes, sir.

Q. Now, in discussing adsorbents in vessels in general, if one maintains a feed on the vessel for a long period of time is there heat generated in the vessel? A. There is always heat generated in the vessel when adsorption proceeds.

Q. And if it proceeds for a period of time what happens to that heat quickly, Dr. Meissner? A. That heat gets warmed up into the upper reaches of the bed and then finally leaves the bed either in the form—in the form of

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hot gases out of the top of the bed and also by radiation to the surroundings.

Q. What happens to the heat that is used out of it, [75] that is washed out of the top of the bed? A. Well, as far as practicable apparatus is concerned, that heat then is lost to the bed.

Q. Can that be recovered for desorption? A. It cannot.

Q. What happens to the heat that radiates from the sides of the vessel? A. That, in turn, is lost from the vessel and cannot be reused by the bed in the restoration cycle.

Q. How does one then desorb when he has lost the heat generated during adsorption? A. One desorbs by finding another sort of heat to restore that part, to make up for that part which the bed had lost.

Q. Typical sources, another typical source of heat would be what? A. For example, it would be heated surfaces buried within the adsorbent within the bed. Alternatively, it could be that hot gases, that is to say gases that are pre-heated before being blown on the restoration process as such.

Q. Where would those gases come from, Dr. Meissner?

A. They would come from some source elsewhere outside the process.

Q. That would have nothing to do with the product that's being dried? [76] A. That is correct.

Q. It would be an extraneous source? A. It would be an extraneous source of gas.

Q. Now, this is not the Skarstrom invention? A. We are not talking Skarstrom.

Colloquy

Mr. Huettner: Your Honor, I would now like to talk Skarstrom. This would be a good place to break, if it is at all convenient to the Court.

The Court: You won't have any problem with me on breaks. You will only have problems with delays, because I don't think this case ought to take the time that you gentlemen estimated.

Mr. Huettner: We hope to be finished with our case by the end of the week, your Honor; three days.

The Court: The end of the week? You mean to explain this thing? It shouldn't take that.

Now, I had a case, and I'm not talking about a patent case, but I had a rather interesting jury case here where they used a drier to heat fabrics being dried and there they had this material going through on a slow roller to dry and they generated heat. The heat generated at one part with some flame was picked out of the drier and recirculated so that all that heat wasn't lost.

So I in my, what shall I say, amateurish way, [77] I've read the trial brief that you submitted and I gather what happens here is that some of this dry gas that you had, you turn it around and use this for your heat for the purpose of restoring the granules that are used for the purpose of adsorption.

Isn't that, in a very simple way, what happens?

Mr. Huettner: No, your Honor. The heat is not used.

The Court: No. But I said some of the dry gas.

Mr. Huettner: Yes, your Honor, the dry gas.

The Court: Some heat you lose.

Mr. Huettner: Yes, sir.

Colloquy

The Court: But that is in the gas that has already become hot—

Mr. Huettner: No. The whole thing, your Honor, is the gas in Skarstrom never becomes hot.

There is a heat reaction that takes place within the adsorbent bed. That generates heat. That heat never leaves what we call the birth place, where it is created. The gas that leaves the top of the bed is the same temperature as the entering gas. The heat stays within the bed. So that there is no transfer of heat out of the bed.

The product gas that comes out of the top is the same temperature as the entering gas. Heat is [78] generated, but it remains in the adsorption bed. Part of that product is used to purge and in purging it is dry gas because it came out as product from the first bed as dry gas. But at ambient temperature, room temperature.

It goes down and purges the other bed, but it finds that the heat in that bed from the previous adsorption cycle is right there where it was when it was adsorbing and that heat is used for desorption, your Honor. But no extra heat is added.

This is what is so unique about the invention. The heat never leaves where it is born, where it is created in the bed.

The Court: Fine. I understand what it does and you will have to explain a little just exactly how it does it. Then we will get to why it is unique.

But I don't think it ought to take three days to explain what it does.

Herman P. Meissner—for Plaintiff—Direct

Mr. Huettner: No. Our entire case, your Honor, would take three days, I hope.

The Court: Are we going to go into the issue of damages here?

Mr. Huettner: No, we are not, your Honor.

But we have two other witnesses in addition to

* * * * *

[127] tion to passage of the initial stream passed through such zone while it was on adsorption cycle. As thus introduced, the discharged primary effluent product is relatively free of the key component or components retained by and present in the adsorbent contained in the zone on a desorption cycle."

The Court: It is dry gas at that point?

Mr. Huettner: That's right.

The Witness: Yes, sir.

The Court: All right.

A. (Continuing) "Also the adsorbent therein will have been slightly heated by the heat of adsorption induced during a previous adsorption cycle. By proper adjustment of the adsorption-desorption cycle periods, the heat of adsorption during the pressure cycle is conserved and available to counteract the effects of cooling produced during the desorption cycle.

"One great advantage of the present process is the conservation of heat evolved on the adsorption cycle. Processes as heretofore known in the art conducted the adsorption cycle for a period sufficient to raise the delta T appreciably."

Herman P. Meissner—for Plaintiff—Direct

By the Court:

Q. What is delta T? A. The term delta T uses engineering parlance here. Delta T signifies typically a difference in temperature. Any [128] difference in temperature is often called a delta T. So that the phrasing then is "period of time sufficient to raise the delta T appreciably."

That would mean then the difference in temperature somewhere in the reaction zone itself, the temperature somewhere in the reaction zone itself as compared with what it was before this zone went on stream. In other words, it's a difference between the temperature as of now and a temperature as it might have been at the outset of some operation. And this difference increases with time.

By Mr. Huettner:

Q. Now we are talking about change in temperatures for what, Dr. Meissner, at this particular point so there is no confusion? A. We are talking about a change in temperature of the bed material.

Q. For what operation? A. In the adsorption.

Q. Would you refer to what you are reading and tell me what operation we are referring to? A. I am reading from Line 64.

Q. What is 64? Would you start at 64 and please read it? A. "Processes as heretofore known in the art conducted the adsorption cycle for a period sufficient to raise the [129] delta T appreciably."

Q. What process are we talking about? A. We are talking about the processes as represented by the—

Herman P. Meissner—for Plaintiff—Direct

The Court: Desorption?

A. We are talking about an adsorption process. We are talking about a process wherein a wet gas is being passed through a bed of adsorbent.

Q. Are we talking about the Skarstrom process? A. No, sir.

Q. Absolutely not? A. No, we are not in this case.

In this particular case we are talking about what happens generally when we pass a gas stream through a bed of adsorbent and as we continue to pass that gas stream through the bed of adsorbent the delta T, so-called, increases with time.

Q. All right. Now would you continue reading? A. "... thereby permitting or causing heat to flow through the bed, as well as through the walls of the adsorption vessel, thus to be substantially lost. In accordance with the present invention, wherein rapid cycling is employed between the adsorption and the desorption phases, the delta T on the adsorption zone is relatively small."

Q. Would you explain that? [130] A. Adsorption and desorption phases. First the adsorption and desorption phases with respect to a particular vessel would be represented by the vessel in these two cycle periods.

Q. Would you refer to 4-A, please, in your discussions, Dr. Meissner? A. Thank you. In Exhibit 4-A vessel 2 is on adsorption in this first cycle period. As shown in Exhibit 4-B vessel 2 is now, during the second cycle period, on desorption.

As indicated, of course, by these designations up at the top of the chart which help us keep track of the pressure.

Herman P. Meissner—for Plaintiff—Direct

Now, then, the sentence went on to say, "In accordance with the present invention, wherein rapid cycling is employed . . . the delta T on the adsorption zone is relatively small."

Cycling is rapid in the sense that the switchover from the first cycle period to the second cycle period occurs frequently. And under those circumstances then the temperature of the reaction zones do not have time to build up at all much during an adsorption phase.

"This tends to greatly reduce the flow of heat."

This does tend to reduce the flow of heat, because in Skarstrom's short cycles the heat of the gases being adsorbed pass through the reaction beds for relatively short periods and therefore retain most of the heat of adsorption within [131] the reaction bed, within the reaction zone.

Q. Dr. Meissner, would you refer to Exhibit 4-A when you are talking about adsorption? A. I beg your pardon. Thank you. I did confuse things. I apologize.

During the first cycle period, Exhibit 4-A, vessel No. 2 on the right is clearly on adsorption during that half cycle period.

Now, in a Skarstrom type operation the flow of gas through the bed on adsorption is relatively limited. As a result of this knowledge of the heat generated in the reaction zone of this bed on the right, bed 2 on adsorption, little of that is washed out of the system into the upper reaches of the bed. Most of it stays in place, that fraction of it, that small proportion of it that is washed out is caught as it were by the bed immediately adjacent to the top of the reaction zone.

Herman P. Meissner—for Plaintiff—Direct

Q. Now I think you are on Line 73. A. "Due to the short time on the adsorption cycle, heat will not have time to flow through the bed, and through the walls of the vessel into the surrounding atmosphere."

In other words, because the time is short heat will not flow during adsorption any great distance upstream into the bed up above or out through the walls of the vessel.

"By rapid cycling from adsorption to desorption in [132] the respective zones, the desorption cycle will substantially completely utilize the heat produced during the adsorption cycle."

In other words, by using cycles of this type the heat which has been washed upward out of the reaction zone during adsorption is readily available for reuse. It has remained close enough to its birth place so that it can be reused during the subsequent regeneration or desorption step.

Q. I think you are on Line 4, Column 7. A. Thank you.

As pointed out above, this is due to the low delta T attained, and due to the lack of time for dissipation of the heat of adsorption. In effect, the beds function as highly efficient, rapidly cycled, bead heat exchangers. Generally, the time on the adsorption cycle in accordance with the present invention does not exceed 2-3 minutes and is preferably less than one minute."

In other words, two to three minutes in the first cycle period as indicated by Exhibit 4-A, another two to three minutes on the second cycle period, Exhibit 4-B, and then back to 4-A again and so on.

"A very desirable time on the adsorption cycle is less than 20 seconds as, for example, 10 seconds. The particu-

Herman P. Meissner—for Plaintiff—Direct

lar times utilized depend upon various factors, such as the particular adsorbent utilized, the height of the bed, the [133] nature of the key component, and other operating variables."

Q. What are the other operating variables that have some significance to this, Dr. Meissner? A. Certainly factors like the velocity of the gas traveling up through the bed. The velocity of the gas traveling up through the bed is a factor. The size of the granules used is, to a degree, a factor.

The type of adsorbent—I guess they have mentioned the type of adsorbent used. But it is factors of that sort which would influence the choice of—

The Court: The pressure?

The Witness: Pressure would be a factor, yes, sir.

The Court: That would regulate the speed?

The Witness: It would, indeed, yes.

And also the amount of moisture, of course, the moisture content of the entering gas; that, too.

The Court: All right.

A. (Continuing) "The combination of temperature and reduced pressure, plus the flushing or scavenging effect of the primary effluent product reflux portion used for backwashing, prepares the adsorbent to adsorb the key component or components from the stream of the gaseous mixture introduced during the next adsorption cycle for this zone."

The combination of temperature and reduced pressure—

Herman P. Meissner—for Plaintiff—Direct

[134] Mr. Huettnner: Wait.

Is there any question on that?

The Court: No. You have cleaned out the moisture so now it makes it easier to use it for adsorbing on the next round.

Mr. Huettnner: We have used some other words in there that are new, but I guess they are perfectly understood.

Q. Please proceed, Dr. Meissner. A. "Desorption of the adsorbed key component is additionally facilitated by the fact that the gaseous mixture constituting the primary effluent product reflux portion which is passed through the zone has acquired a renewed capacity to take up the key component desorbed from the adsorbent. In effect, the desorption step, accomplished in one zone of a pair of zones, involves a backwashing action by the primary effluent product reflux portion withdrawn from the primary product stream discharged from the contemporary adsorption cycle of the other zone in such pair, and may be accomplished without addition of heat from an outside source."

Q. And the addition from an outside source is what, Dr. Meissner? Addition of heat from an outside source? A. The addition of heat from an outside source might be accomplished, could be accomplished, has in the past before [135] Skarstrom been accomplished in either of two ways:

One of them would be to have immersed in the bed of adsorbents, of course, an electrical heater. A second method would be to preheat, to heat externally the purge

Herman P. Meissner—for Plaintiff—Direct

gas to some high temperature so that the purge gas itself now hot and at a significantly higher temperature passes through the bed of the reaction zone and because—

The Court: Pass the gas through a heater or you put a heater in there?

The Witness: Yes, sir. Alternatives. And they amount, in a sense, to the same thing.

In either case it is heat being supplied from an outside source. This is what Skarstrom does not do.

By Mr. Huettner:

Q. What are the disadvantages of having a heater in an adsorbent bed in the nature you have just described? A. Well, of course, in the first place it complicates the system, it makes it costlier, it is more prone to breakdown and since there's an additional maintenance—

The Court: It is harder to get at, it interferes with the flow?

The Witness: Precisely. And also the heating from a heater or, indeed, with external gas means that the adsorbent is subject to higher temperatures [136] than it otherwise would be. The adsorbent cycles through a greater temperature range is more apt to crack and split and fall to pieces. These adsorbent beads are really very strong, but after a few hundred or thousand cycles, if they go through wide temperature swings, they are apt to go to pieces. So it reduces its life.

Herman P. Meissner—for Plaintiff—Direct

Q. Now, Dr. Meissner, without reading any further in the patent in suit, would you briefly tell us what the remainder of Column 7 describes? A. Column 7 describes various other methods, modifications of the Skarstrom operation and then is followed by the material on Column 8 which represents a particular example, including flow quantities of operation of a Skarstrom device, of a Skarstrom heaterless drier.

Mr. Huettner: Your Honor, we initially were going to go through that part of Column 8, but we have deleted it. We believe it is sufficiently clear, in view of what we have already described, that one can follow the example that is set forth, unless you would care for us to go through it. It is a flow description of the operation going—

The Court: You can forget everything after the “unless”.

Mr. Huettner: Pardon?

[137] The Court: I say you can forget everything after the “unless”.

“Unless I prefer that you go through with it”. You can forget that part.

Mr. Huettner: Okay. We will not go through it, your Honor. But we believe it's a description of the operation.

Q. Dr. Meissner, can you tell us what the remainder of the patent specification, that is through Column 17, what that describes with relation to this litigation or its significance for the Court to understand with regard to this litigation? A. The remainder of this patent largely talks

Herman P. Meissner—for Plaintiff—Direct

about the application of the Skarstrom heaterless drier invention to other gas mixtures and complex gas mixtures.

And by "other" I mean other than air, other than the air water system that we are discussing here, and so does not have direct relevance to air drying.

The Court: More complex chemical problems?

The Witness: Yes sir, more complex chemical problems, yes sir, and a staging of the system for binary mixtures that are especially difficult to separate; not air and water.

Q. Dr. Meissner, is it essential that the Court understand the remainder of the patent specification through Column 17—

* * * * *

[143] bed on the left in 4-B.

The last two photographs, your Honor, 4-C and 4-D, show the extremes of the beginning of adsorption for the bed on the right and the end.

The Court: You mean these swatches on the side?

The Witness: Yes, they are to show magnitude schematically.

The Court: All right.

(Plaintiff's Exhibits 14-A through 14-D: Marked full exhibits.)

By Mr. Huettner:

Q. Now, Dr. Meissner, you avoided the issue of temperature or heat— A. Which should now be faced up to.

Herman P. Meissner—for Plaintiff—Direct

The Court: Well, I wasn't trying to make an issue of it. I was just trying to find out.

A. During the adsorption operation then back on the first cycle period as shown by Exhibit 4-A, as moisture is being picked up, is being adsorbed in the reaction zone and the reaction zone rises during this period, heat is being generated. The zone is getting hotter. And whilst it gets hotter therefore it inevitably transfers some of the heat that it is generating to the gas passing through it.

This zone therefore, while it moves upward, is being traversed by relatively cold air. That relatively cold [144] air is being heated and as a result of this heating then the air, now relatively hot as it rises through the reaction zone, finds its way into the cooler bed up above the reaction zone but immediately adjacent to it.

After all, heat is generated within the reaction zone. It is not yet being generated above the reaction zone because no adsorption is going on above the reaction zone.

By the Court:

Q. There is no reaction, therefore no heat? A. Therefore no heat.

So the hotter gas—I say hot; that's perhaps a strong word. But the gas which has picked up some increase in temperature surrenders some of the heat to the colder regions of the bed above the reaction zone.

Q. It is cooled off? A. And it is cooled off.

Q. It is not reacting any more? A. Yes, sir.

So as the flow continues, of course, a certain amount of

Herman P. Meissner—for Plaintiff—Direct

the heat generated within this bed finds its way into the upper regions of the bed.

Q. By conduction or how? A. Well, I think this we would call convection rather than conduction, although there is conduction involved. These terms are used differently in the industry.

[145] Q. All right. Go ahead. A. The amount of heat generated in the reaction zone which is carried into the upper reaches of the bed, however relative to the total heat development, is relatively small. Most of the heat in a short cycle remains within the reaction zone.

Now, in addition, the reaction zone itself in the Skarstrom invention travels, in the times that we are talking about, the zone itself travels only a very small distance. Here the distance of travel has been lengthened as indicated by these columns left and right. It looks as if the reaction zone traveled this distance. In other words, from this position to that one.

In the Skarstrom invention, which involves a short cycle time, the length of travel is very small. As a matter of fact, it is of the order of magnitude of less than one per cent typically of the total height of the bed.

Now, it is a combination of this small degree of travel in the short blows and the short cycle time with limited amount of gas going through this bed that means that most of the heat generated within this system remains, may I say, close to its birth place. That is to say, most of it is in the reaction zone, a little bit of it has been blown into the zone immediately above.

Q. So? [146] A. Because of this circumstance on a reverse blow, on regeneration, that heat is easily restored

Herman P. Meissner—for Plaintiff—Direct

to the original bed. It is for this reason that the Skarstrom invention operates. Because of the fact that most of the heat remains within the bed itself.

Q. Then any of the effluent coming back picks up that heat? A. Yes, sir. The effluent coming back is able to pick up that heat and restore it to the bed.

By Mr. Huettner:

Q. Why do you need it restored to the bed, Dr. Meissner?

A. Because, of course, it is essential to supply to the bed just as much heat or have available within the reaction zone just as much heat during desorption as was developed during adsorption.

The total heat involved in depositing moisture and having this adsorbent pick up moisture causing this reaction zone to travel upward, the heat involved then in this first cycle period during adsorption exactly equals the heat required in this part of the operation. If there is no balance then we cannot continue to operate this thing.

I beg your pardon, sir, I interrupted you.

By the Court:

Q. Well, you are explaining what happens in terms of temperature now? [147] A. And heat supply.

Q. And I asked you before whether you had prepared this by measuring the heat. Now, this may be a scientific explanation that you have to have some heat there. A. This explanation is based upon temperature measurements and composition measurements made at various points within the bed.

Herman P. Meissner—for Plaintiff—Direct

Q. All right. This is based on temperature measurements. A. Yes, sir.

Q. Okay. A. Now, the facts are then that in the operation of the Skarstrom system heaterless driers it turns out that the beds, the reaction zone at the end of the adsorption period can be restored during the following desorption period to the point of its origin.

In other words, the reaction zone rises and then falls again to the position that it started from. This is accomplished using a fraction, a part of the dry outlet gas product, the primary product gas.

In other words, a part of this gas is recycled to be used as dry purge in this operation. Leaving, however, a very significant fraction, three-quarters for example, of the gas available for use elsewhere.

The Skarstrom invention, therefore, is an invention whereby a set of operating conditions has been found whereby [148] it is possible to regenerate the bed with a part, but only a part of the dry product gas, allowing the remainder of the product gas to be utilized elsewhere.

The Court: Well, that's one way of doing it, I suppose.

Mr. Huettnner: Yes.

By Mr. Huettnner:

Q. And does it require any external heat? A. Without external heat. This is done without external heat. The critical factor is that it is to be so accomplished.

Herman P. Meissner—for Plaintiff—Direct

By the Court:

Q. Yes. Well, I mean you could hook up a little stream of cold air to run through this and it would do the same thing as far as reducing the heat. You wouldn't have to use the adsorbed effluent or a part of that to reduce the heat.

It happens to be handy and it is cool and you can do it, but I suppose as far as cooling goes you could put in anything, couldn't you, if it was dry? A. If you used cold air taken from the room and undertook to regenerate the bed with cold air from the room you would accomplish no regeneration to speak of because the cold air from the room, you see, would carry the moisture that you are trying to eliminate. So you would contaminate the bed.

Q. All right. A. You could regenerate the bed if you took that cold [149] air and heated it very hot, you see.

Q. You mean to get the moisture out of it? A. So it turns out that at high temperatures adsorbents will surrender the moisture that they hold much more easily than at the temperatures that we are talking about. And it is not necessary to regenerate with as dry air at high temperature as at low temperature.

If you heat, for example, air to several hundred degrees Fahrenheit, four or five hundred degrees Fahrenheit, let us say, that air, even though it carries some moisture, will regenerate an adsorbent bed. But that heat has to come from some outside source.

So that, you see, that is clearly not the Skarstrom invention.

Herman P. Meissner—for Plaintiff—Direct

The Court: I don't want to suggest any improvements on this system. I'll accept this one.

All right.

Mr. Huettner: Your Honor, we have here a model which is attached to a compressor that we have set out in the hallway and we have a feed line coming in and we would like to just run the model to show you.

You won't see a great deal, but I think it might be interesting for you to see what one can see and hear with regard to the operation of a heaterless drier in your courtroom.

* * * * *

[167] HERMAN P. MEISSNER, resumed, having been previously duly sworn, was further examined, and testified as follows:

Mr. Huettner: Your Honor, yesterday at the conclusion I asked Dr. Meissner to calculate rapidly some figures which would tell us how much water there was in the air in this room and how much water there would have been in the air had it gone through the drier and reduced to 20 parts per million.

The Court: Yes.

Mr. Huettner: And he made some calculations in his head.

Direct Examination by Mr. Huettner (Cont'd):

Q. Dr. Meissner, were those calculations accurate? A. They were not.

Q. Would you kindly advise the Court, have you recalculated? A. I have.

Herman P. Meissner—for Plaintiff—Direct

Q. And would you tell the Court what those calculations are? A. With my apologies, it will take just two minutes.

The calculations I performed yesterday went as follows: If the room here contains 40,000 cubic feet of air and if that air contains 7,000 parts per million of water, then the water content of that quantity of air is 13 pounds. I [168] erroneously said 80 yesterday, I believe.

Thirteen pounds is about a gallon and a half of water, something like that, if that will help visualize the quantity.

We made a second calculation. What was the quantity of water which air of this size, a volume of air of this size, namely 40,000 cubic feet, would contain if the water condensation, the water volume were 20 parts per million?

The answer to that one is 1/30th of a pound. These are round numbers, but good enough; 1/30th of a pound.

The Court: Would be removed?

The Witness: Would remain.

In other words, the removal in going from 7,000 parts per million to 20 parts per million represents a reduction of equivalent to taking 349 parts out of 350 parts, leaving one over.

I got those numbers because, of course, 7,000 divided by 20 gives the number 350.

The Court: Okay.

Mr. Huettnner: Your Honor, I think I have only marked for Identification the apparatus that we witnessed yesterday afternoon, the one that Dr. Meissner described and we watched its performance, which has been marked P-15 for Identification.

Herman P. Meissner—for Plaintiff—Direct

I would like to have the apparatus introduced into evidence as Exhibit P-15. We have taken some [169] Polaroid photographs of it and I would like to introduce the photograph as Exhibit P-15-A, so that if the apparatus is not conveniently available at least the photograph might be of some assistance.

The Court: All right. Full exhibit.

(Plaintiff's Exhibit 15-A: Photograph of model apparatus, marked full exhibit.)

The Court: Strike the identification on the machine.

Well, you can strike it, anyway, but I don't think it will be necessary to keep this physical exhibit in the custody of the Court after this case is tried.

Mr. Huettner: It will not be. If your Honor wants it, of course we can leave it. It will always be available to inspection for the attorneys for the other side if it is removed from the court.

The Court: Very well.

(Plaintiff's Exhibit 15 for Identification: Marked full exhibit.)

Mr. Huettner: And the photograph is just so that we have a visual picture of what we had here in court.

The Court: Good idea. All right.

Mr. Huettner: I would like to introduce into [170] evidence as Plaintiff's Exhibit 5-E a copy of the British Patent No. 677,150. This is one of the patents that has been noticed by the defendants.

(Plaintiff's Exhibit 5-E: British Patent 677,150, marked full exhibit.)

Herman P. Meissner—for Plaintiff—Direct

By Mr. Huettner:

Q. Dr. Meissner, have you had an opportunity to study the British patent—and I will refer to all patents by their last three numbers—the British '150? A. Yes, sir.

Q. Dr. Meissner, what is the subject matter of the British Patent '150, Exhibit 5-E? A. This patent relates to the removal of carbon dioxide from air in adsorption process for later use of this air in an air liquefaction operation.

Q. And can you tell me, Dr. Meissner, what kind of a process is used? A. In this process the washing gas, as it is named in the patent, the washing gas in the desorption operation or adsorber regeneration is gas which is always obtained from a process elsewhere in the plant.

Q. What kind of a process are we talking about here, Dr. Meissner? A. The process operated in combination with the drying operation described in Patent '150 is an air liquefaction operation. [171]

Q. What is an air liquefaction operation? A. This is an operation in which air is chilled to low temperature, made liquid, and separated into its components primarily oxygen and nitrogen.

It is, of course, to be recognized that in the remainder of the plant that there are more parts to it probably than the air liquefaction operation, air separation operation. There are other operations as might be typical in any large chemical plant installation.

Q. To give the Court some idea of just physical size of an air liquefaction operation, how big an area does a plant of such nature occupy? A. The liquefaction operation itself might be located in a room of about this size, as far

Herman P. Meissner—for Plaintiff—Direct

as floor area is concerned. The apparatus, itself, involving towers would, of course, reach upward a considerable distance.

Q. Does the British Patent '150, Exhibit 5-E, say anything about the amount of washing gas used? A. Yes, it does. It points out on the first line, for example, of Page 2, that would be line 1 of Page 2, it says there that a quantity of washing gas equal to 3 to 4 times the effective volume of the untreated gas is used.

There are further mentions to the matter of gas usage.

[172] Q. What gas? A. Purge gas usage.

At the highest pressure ratios used, according to Claim 7, which is on Page 4 of the patent, the bottom of the first column:

“Process as claimed in any of claims of 1 to 6, wherein with the same volume of untreated gas and washing gas at normal pressure, the pressure of the untreated gas is made 3 to 4 times higher than the pressure of the washing gas.”

In other words, in this case, the volume of the untreated gas and the washing gas taken at equal pressures, the volumes are equal. Taken at equal pressures and, of course, also equal temperatures implied.

So that at high pressures, as defined here, pressure ratio of 3 to 4, that is to say the pressure on the adsorber is three or four fold greater than on the desorber, under those circumstances then the initial volume of the washing gas and of the untreated gas fed to the system are equal.

When, however, the operations are conducted at lower pressures, then greater volume ratios are used. That is to

Herman P. Meissner—for Plaintiff—Direct

say, instead of having a ratio of one volume of washing gas per volume of product gas, the ratio goes up rapidly.

In the example on the top of Page 3 there is described there actual gas volumes used for washing and for feed which are reported for the case cited.

[173] The Court: Where is that on Page 3?

The Witness: This is on Page 3, first line 74, the volume of the feed gas is reported there and perhaps I should read that sentence:

“Air containing 0.03 per cent”—

By Mr. Huettner:

Q. Where are you reading, Doctor? A. I'm reading starting at Line 67.

“Air containing 0.03 per cent carbon dioxide is passed at 1.4 atmosphere absolute pressure and at normal temperature through one of the two parallel-connected adsorbers filled with a layer of activated charcoal of length 1.5 meters, at an hourly rate of 600 cubic meters of adsorbent.”

In other words, the feed rate then at this pressure of 1.4 atmosphere in the example cited is at a rate of 600 cubic meters per cubic meter of bed material.

Those units sound awkward, but if the feed ratio is 600 cubic meters per cubic meter of bed, the feed ratio per cubic foot of bed would be 600 cubic feet. So that the feed here under a pressure of 1.4 atmosphere is 600 cubic feet per cubic foot of bed at a pressure 1.4 atmospheres.

Herman P. Meissner—for Plaintiff—Direct

Again down below: "After a charging period of 10 minutes, the adsorbers are changed over in known manner"—I am reading now on Line 76 and so on—"and the charged adsorber is washed, for 10 minutes, with nitrogen free from [174] carbon dioxide at 1.15 atmospheres absolute pressure, at the same temperature and at an hourly rate of 2400 cubic meters per cubic meter of adsorbent, while the partially discharged second adsorber which has meanwhile been washed is charged."

In other words, whilst the bed undergoing the adsorption phase of this operation is fed with 600 cubic feet per cubic foot of bed per hour at a pressure of 1.5 pounds, the other bed which is desorbing is fed with a washing gas having a volume of 2400 cubic meters per cubic meter, or 2400 cubic feet per cubic foot of bed. This gas at a pressure of 1.5 atmospheres.

Again then that would mean that per hour every time 600 cubic meters of air at pressure is fed, that is the raw feed, simultaneously 2400 cubic feet are fed for washing purposes.

Now then, in comparing these quantities, of course, it is inconvenient and improper if we are interested in relative masses of gas to compare gas quantities, gas volumes which volumes exist at different pressures. After all, as we discussed yesterday, if we have a gas stream traveling at pressure and we divide that gas stream into two parts, the volumes of the two parts are the same as the initial volume of the gas stream flowing, providing there is no reduction in pressure and temperature. The additivity of volumes then applies. The volume downstream on the one stream and the other, [175] those two volumes sum to the initial feed stream volume.

Herman P. Meissner—for Plaintiff—Direct

By the Court:

Q. How can you compare; I mean does it make a difference that you are dealing with a different chemical composition in the gas? A. No. In that these gases all have very similar behavior under pressure; that is to say, they all respond to pressure equally.

You remember that the pressure volume relationships, the change in volume of a gas with pressure was always in the inverse relationship. That is to say, the volume varies inversely with the absolute pressure. And this is true for all gases.

Q. I didn't mean in that sense. I meant it in the sense of the adsorber is different and its adsorption— A. Will differ.

Q. Because of the chemical nature of the gas? A. I would agree. That is correct, yes, sir.

Q. Well, if that is so, then we have some variables here that make a direct comparison kind of doubtful. A. The point—

Q. I mean in one you are picking up, in the device at issue, you are picking up water or removing water; and in the other it is a different gas. A. Well, it is nitrogen in this case apart from oxygen.

[176] The purpose of my development at the moment is to indicate that the quantity of the washing gas used, which you are quite right in saying is different than the feed gas; it is quite different. The quantity of the purge gas, however, is much greater than the quantity of the feed gas.

Q. I understand that. That's pretty clear. A. Very good. The reason why I felt that it was desirable to emphasize this circumstance was because this is an operation

Herman P. Meissner—for Plaintiff—Direct

which is quite unlike the Skarstrom patent device that we were examining yesterday.

Q. Yes. But are you saying that the Skarstrom device could be used for the particular purpose of adsorbing the carbon dioxide? A. Yes, sir, it could.

Q. The same as the '150 process? A. Yes, sir. But the type of operation would have to be different.

Q. All right. So it has to be a different operation. And that's because of the different chemical nature of the adsorber and of the gas that has been adsorbed? It has to be washed out? A. The Skarstrom device can, of course, work on any system. It is not unique necessarily to the alumina that we were talking about yesterday. It could as well work on this carbon that is used in this process and this gas feed.

[177] Q. Do I understand you to be saying that it would work as efficiently on the removal of carbon dioxide and the recharging, whatever they call it, of the adsorber as it does here with water? A. Yes. It would work, yes.

The adsorption characteristics of charcoal, as I remember them, would indicate an equal kind of success in separation. That is to say, the carbon dioxide content of the effluent air, after treatment, would be reduced to very low levels.

In the Skarstrom device, as it may be here, we have no direct numbers regarding the success of this operation. But the Skarstrom device would do very well in this kind of an operation given the proper adsorbent and given the proper operating cycle.

May I explore the difference between the two? It might help the development of thinking.

Herman P. Meissner—for Plaintiff—Direct

Q. Well, I can't compare unlike things to each other—
A. Of course.

Q. —and make a judgment of relative efficiency, unless the unlike things react or are treated as effectively. And without a test on the machine at issue here, I don't know.

You say that theoretically this machine, the Skarstrom machine, should do as well with carbon dioxide as it does with water? [178] A. Yes, sir. I'm persuaded that it would.

Q. All right. Then I can see that there is a considerable difference in efficiency, on that premise. A. To discuss that point a little further, the interesting observation to be made here, as you just did, that the volume of the purge gas, of the washing gas is in significant excess over the volume of the feed gas to be processed.

Indeed, the ratio of these two gas streams is 3 to 1; that is, roughly threefold the volume purge gas as there is to the feed gas.

It indicates then that a type of operation which is basically different than Skarstrom. In the Skarstrom heaterless drier you will remember that the feed to the device after passing through the adsorbent on the adsorption cycle split into two parts and roughly 15 or 20 per cent of that gas—

Q. Well, I think that is evident, that the volume is significantly less in the Skarstrom machine. A. Yes, indeed.

Q. I think that is clear. A. Then in that case this operation that is being described here—

Mr. Huettner: In the '150 British patent?

Herman P. Meissner—for Plaintiff—Direct

A. —in the British Patent '150, this purge gas could not possibly have come from the dried or the purified feed gas. It must have come from some other source. That is the point [179] I've been laboriously worrying about.

The Court: All right.

By Mr. Huettner:

Q. That is because why, Dr. Meissner?

The Court: The volumes that are used.

A. In using a volume of purge gas measured in terms of standard units, standard volumes, the volume of the purge gas is smaller than the volume of the feed.

Q. In this case are we talking about now? A. In the Skarstrom case the feed was divided into two parts and one part was used for purging and the remainder was available elsewhere for operations elsewhere in the plant.

Q. Now, in the British '150 what is the volume of purge to feed? A. In the British '150 the volume of purge to feed is large. It is three, it is roughly three.

Q. Can the purge then, therefore, be the product in the British '150? A. No. The purge, of course, would not be the product.

In British '150, if Skarstrom were the basis of this operation there would be no product at all. There would not have been any product produced because the volume of purge required in this regeneration is so great that it could not have been provided from the feed. Additional gas had to be brought into the system from some other source in order to provide all [180] of the purge gas.

Herman P. Meissner—for Plaintiff—Direct

Q. Does the British '150 patent tell you anything about cycle times? A. Yes, it does talk about cycle times.

Q. And cycles of adsorption and desorption? A. Yes. The patent number cycle times are stated in this patent on Page 2, Line 39:

"The adsorption/desorption time is substantially between 5 and 30 minutes."

They accomplish this short cycle time by the use, however, of a relatively large amount of purge backwash.

Q. Would you again just tell his Honor where you are reading from, Dr. Meissner? A. I was not reading from the patent then.

Q. Would you tell him where you are in the '150 British patent? A. I beg your pardon. On Line 38 of Column 2, your Honor.

Q. Page 2? A. Page 2. I beg your pardon. Page 2, Line 38.

Q. Now, Dr. Meissner, does the patent teach you what to do if you are operating under pressures that are followed in Skarstrom with regard to cycle time? A. No, it does not teach you what to do in the Skarstrom type operation. As a matter of fact, the kind of operation that [181] is described here in '150 in which successful purge is carried out, successful regeneration purging of the bed is carried out with a large volume of purge gas, that is to say with a threefold volume of purge gas relative to the feed gas. This represents the kind of operation that I would have expected would be possible before reading the Skarstrom patent.

Herman P. Meissner—for Plaintiff—Direct

It is exactly in this circumstance that the Skarstrom is able to operate with a purge quantity small enough so that he gets a product left over from the dried product that emerges from the adsorber on the adsorption cycle. It is the fact that he can split that product stream out of the adsorber into two parts and use one part to purge the adsorber which is being desorbed, which is on the regeneration cycle, and still have gas left over, which to me was very surprising when I first encountered this circumstance. I would have, instead, expected that a much larger quantity of purge gas would have to be used. And indeed until I saw the apparatus actually operated I must confess I was somewhat skeptical about the success before I saw the Skarstrom apparatus demonstrated. I was skeptical about the feasibility of using a purge gas volume of a size such as the split stream here generated in the Skarstrom device. I would have expected that purge volumes much larger would have been required.

By the Court:

Q. Now, the purge gas used in '150, is it treated or [182] untreated gas? A. The patent indicates that it is dry gas, but gives us no indication as to where that nitrogen came from. It apparently is nitrogen. We do not know what its derivation was.

The Court: All right.

By Mr. Huettner:

Q. Dr. Meissner, does the British Patent '150 describe any problems on switchover, changing from adsorption to

Herman P. Meissner—for Plaintiff—Direct

desorption, and the length of cycles? A. The length of cycles is so selected that the switchover, as indicated in the first claim—

The Court: Well, the adsorption you said takes 5 to 30 minutes?

The Witness: Yes, sir.

The Court: And the patent says that the washing takes about 10 minutes?

The Witness: I think that the patent implies, as in all of these operations, that the time period for adsorption is always matched by the time period spent on desorption.

There are tandem beds here again, one on adsorption and one on desorption.

So that whilst one bed is on the adsorption part of a cycle period, the other bed is on the desorption [183] part of a cycle period. This is indicated, for example, in Claim 1, Line 6 on down from there, "by means of two adsorbers which are arranged to be periodically changed over and partially regenerated," and so on.

The Court: Well, when it says "the adsorption/desorption time being substantially between 5 and 30 minutes" you say that whatever that time is that they are equal on both sides?

The Witness: Yes, sir, I would expect that.

The Court: All right.

The Witness: Now, the determination as to what that time might be at which changeover is undertaken is such that the bed is charged to under 50 per cent of its

Herman P. Meissner—for Plaintiff—Direct

equilibrium charge so-called. I'm again reading from Claim 1, Line 10. And below 90 per cent of its breakthrough charge.

Q. What does this mean to you, Dr. Meissner? A. In other words, the bed is operated in such a way that it is close to what we would call the breakthrough point. That is to say—

Q. Breakthrough of what? A. The adsorbed, in this case, carbon dioxide. The key component has moved in the reaction zone through the bed that we were talking about, the kind of beds that we were talking [184] about.

You remember yesterday the reaction front moves on up. And this reaction zone then containing the adsorbed carbon dioxide has come to a distance which is below 90 per cent, but presumably then close to 90 per cent of the total distance up through the bed. If it advanced another 10 per cent, if it were now 90, there would be complete breakthrough.

That is to say, the active zone in which carbon dioxide is being adsorbed has moved so that it has reached the top of the bed or has come close to the top of the bed and on breakthrough it would have reached the top of the bed and carbon dioxide would then be found in higher concentrations in the gas leaving the bed.

After all, if we continue blowing gas containing carbon dioxide through this bed, the bed finally will adsorb all of the carbon dioxide that it is capable of adsorbing and after that the bed will be acting as a pipe with some rocks in it. And there will be no adsorption at all.

The patent here says that operations will stop at least 90 per cent of the distance prior to that.

Herman P. Meissner—for Plaintiff—Direct

By the Court:

Q. Sure. You could have the same thing apply to this patent if you just had a shorter bed, that's all. A. That's a well taken point, yes sir.

Q. Is that right? [185] A. That would be true with a shorter bed.

Q. And you would get to 90 per cent of breakthrough and 50 per cent of equilibrium just by shortening the bed. So I mean I don't know that that is of any significance, is it? A. As a further feature that is important, of course, in this bed, the bed in the Skarstrom operation, in that it is necessary to have additional bed material up above to be, as it were, a heat depository.

You remember that as adsorption proceeds heat is washed, in part, out of the reaction zone and there's a heat-wave that is advancing ahead of the reaction zone into the bed, into the part of the bed above the reaction zone. There must be sufficient bed present to capture that heat.

Q. I know. A. If the reaction zone approaches as close as a 90 per cent breakthrough is indicated, then of course the heat will have reached to the top of the bed—

Q. You understand by breakthrough the point at which the gas has been purified or adsorbed, right? A. Yes. By breakthrough I have meant the time when the key component, namely the carbon dioxide in this case, finds its way through the top of the bed and into the gas, is no longer adsorbed.

Q. All right. A. And if the reaction zone marches this far up into the [186] bed, then we are in difficulties with the heat because now we have heated gas, gas at a higher temperature leaving the top of the bed because, of course,

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the heated zone, the heatwave travels ahead of the reaction zone.

Q. I understand that. But with this bed in the Skarstrom device you have a very substantial margin of— A. Deliberately.

Q. Of what? A. Deliberately, yes, sir.

Q. Deliberately? A. Yes, sir.

Q. Why? I mean the heat doesn't go up there. A. One of the beauties of the Skarstrom device is that the cycle time and conditions are always so chosen that the reaction zone moves a very small space indeed.

Q. I understand that, Professor. You got that all controlled.

Then why the margin of another 50 per cent of alumina that apparently is never called upon to function? A. In this bed. Of course, the reaction zone is of finite length.

And I must hasten to say that it is difficult to face up exactly to what the size of the reaction zone is.

Q. I know. I mean we are just— A. I'm confessing this circumstance, that when I present—

[187] Q. Excuse me. A. Yes, sir.

Q. But suppose that this man here—

Mr. Huettner: The inventor, your Honor, of this—

Q. Anyway, in '150, suppose his charcoal—is that what he had, activated charcoal? A. Yes, sir.

Q. Suppose he had made his charcoal bed twice as long as he did. Right? A. He could have.

Q. Then you would get back to 50 per cent or 60 per cent instead of 90 per cent, wouldn't you? A. That is right.

Q. Right? A. That is correct.

Herman P. Meissner—for Plaintiff—Direct

Q. So I mean those figures mean that he was more economical, or thought he was being, in the size of the bed?

A. It's a well taken point.

By Mr. Huettner:

Q. Dr. Meissner, what does the '150 patent tell you with regard to use of the bed? How much of the bed is used?

A. In this case, of course, the use of the bed in his example, he is using he says below 50 per cent of its equilibrium charge.

[188] Q. In other words, if he had a bed twice as long he would still go to the same position that he would go for a shorter bed, is that not true? A. Yes, sir.

The Court: Why?

Mr. Huettner: This is what this man tells us, your Honor.

The Court: I know. But that's because he has a short bed.

By the Court:

Q. Suppose the bed is twice as long. Would he still go 50 per cent of a bed twice as long? A. I think you have a well taken point. He would not have to.

May I just say a word about this—

Q. Well, I don't know, you understand. But it just seems to me the possibility that you can't really get much advantage out of the fact that you use a bigger bed and, therefore, you don't have to use percentagewise as much of it for your process or for desorption. A. The point then I think it would be desirable to develop is the following one. That in

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view of the dimensions of the bed placed here, reported here in these examples, you will notice on Page 2, Line 8 on down—I guess it is Line 6—he reports that the quantity of carbon dioxide understood [189] there added in each case amounts to about 14 per cent of the equilibrium value.

He has roughly the kind of bed depth that we have been talking about in our larger units in the larger Skarstrom type units. Bed depths are very similar in the Skarstrom type unit as in this 1½ meter deep unit over here.

The bed movement then reported here on Column 2, as I've just read, amounts to 14 per cent of the height of the bed, because 14 per cent of the equilibrium charge is equivalent to 14 per cent of the height of the bed traversed by the oscillating front of the reaction zone. Whereas, in a similar situation with the Skarstrom type operation the reaction zone oscillates upward, backward and forward, only a distance under 1 per cent.

Now, you had a well taken point before when you said that but these are different systems.

Q. Right. A. The Skarstrom that we are talking about was working on water. This one is working on carbon dioxide.

In a Skarstrom type operation on carbon dioxide, however, the cycle times would be so adjusted that the movement of the bed would not be 14 per cent. It would be kept much smaller. It would be kept, and notice I'm talking about relative distances now—

Q. How do you know? [190] A. Well, because in the Skarstrom type operation—

Q. No. But I mean without actually putting it to use, how could you tell what the effective portion of the bed

Herman P. Meissner—for Plaintiff—Direct

would be for carbon dioxide removal? A. This is something under your control. The shorter the cycle that you choose to operate, if you pass gas up through a bed for, let's say, three minutes, the reaction zone has traveled three times as far as if that same gas had been put up through that bed for only one minute.

In other words, the travel of the bed is determined by the quantity or the duration of gas flow at a given velocity up through the bed. The longer the gas flows through the bed the further the reaction zone travels.

Because you remember that as the laden gas, carbon dioxide or water containing gas comes up through this bed and finds the reaction zone, the adsorbent in that reaction zone picks up the key component and in consequence of picking it up the reaction zone now then moves upward. Because more and more of the solid is picking up the key component, whatever it may be.

Now, then the travel of the bed upward will stop at that time when the instrument, or you having controlled the instrument, tells the device to stop its main blow. So the shorter the time of blow the smaller the travel of the bed.

Have I made that quite clear, your Honor?

[191] Q. Well, I see here you have a margin up above there. A. We do.

Q. What for? A. It is common, of course, in any packed beds to have excess passing because of channeling.

Q. All right. That's excess. A. Yes, sir.

Q. We take off half of the excess. Just take off half of the excess. A. Yes, sir.

Herman P. Meissner—for Plaintiff—Direct

Q. And you take off half and you start to approach the situation described in '150, don't you, for reaction percentage and for equilibrium percentage? A. Well, there is a minimum bed packing that we must have.

Q. I understand there is a minimum and there is an excess. Now, you have excess here, right? A. Yes, some. There is no doubt.

Q. Now, if you put that much excess into '150's bed why wouldn't you have the variation in percentages? Why wouldn't the carbon dioxide be removed when you got to the same distance in actual inches, even though you had an excess of 4 feet beyond that? A. The answer to that would be this way. Imagine the two identical beds that you are postulating, which is very [192] reasonable, one here and one here; Skarstrom/'150, charcoal in either case, gas velocities are the same, we are passing the same amount of gas in the two cases.

Q. Right. A. In the one case—and let's assume it is exactly like '150 here—we would pass gas through that bed for a period of time so that the movement of the reaction zone would be a given space. Now, if the bed were $1\frac{1}{2}$ meters tall and so on, then the bed movement would be 14 per cent of the total.

The Skarstrom bed is of identical size, let us say, and we have it over here on the left. We are using the same gas. We are starting at the same time. We do not terminate at the same time. The Skarstrom operation would be terminated, the adsorption cycle would be terminated sooner, much sooner than this one.

Q. Why? A. Deliberately.

Herman P. Meissner—for Plaintiff—Direct

Q. You mean you would terminate it? A. We would switch over, yes, sir, we would deliberately. We would so set the timer that—

Q. Well, you can set the timer for as little as you want.
A. Yes, sir.

Q. But will that effectively remove the carbon dioxide?
A. No, it won't be removed until then we return to the other half of the cycle, to the desorption stage, you see.

[193] Q. Don't you remove it in the first instance? A. During adsorption stage the bed accumulates. During desorption stage we wash it out again.

Q. All right. Let's accumulate it. You want to accumulate it, adsorb it. A. Yes. But in the Skarstrom we don't want to accumulate it to the degree that the '150 bed does because if we do accumulate it to the degree that the '150 bed does, then we can no longer operate in accordance with the Skarstrom operation.

Q. I know. But what makes you think you can adsorb in a shorter period of time with Skarstrom than with '150 when we are talking about carbon dioxide? A. I see. The adsorption in either bed, of course, continues all the time.

Every cubic foot of gas—I was going to say cubic centimeter—every cubic foot of gas, as soon as it reaches the active zone, will surrender its carbon dioxide to the adsorbent. If I stop that gas flow—and adsorption will continue in either bed as long as flow occurs through the active zone. If, however, I stop gas flow, then adsorption will stop, of course, because the bed is no longer receiving fresh additional gas containing carbon dioxide. I can stop the adsorption process any time I wish.

Herman P. Meissner—for Plaintiff—Direct

Now then, supposing I have a long adsorption cycle

* * * * *

[200] comes in this invention.

It is, as you point out, a process. It is a way of operating a set of beds, operating them on cycles.

Now, they are short cycles. I could qualify and will qualify that in a moment. But they are cycles so chosen.

Q. The same principle is used sometimes, isn't it, these short cycles, when you have welding in the neighborhood where you want to avoid the risk of possible explosion. You don't want to just put a welding torch on there so that heat will be conducted all along the plate on both sides. So that kind of welding you weld by spot welding, or sort of an oscillating kind of a weld? A. Yes.

Q. You get enough heat to form the weld, but you don't get enough heat to spread by conduction, right? A. Quite right.

Q. Well, it is pretty much the same here, isn't it? A. Yes, sir. The objective, of course, that the Skarstrom had and accomplished was to find a device to which he could find a single gas stream under pressure, supply no other forms of energy, and produce out of that device a purge stream and a product.

The Court: No question. It is a very clever use of the device and there is no doubt about it.

All right. Let's move along.

[201] *By Mr. Huettner:*

Q. Dr. Meissner, referring to Page 2 of the '150 patent, the British patent Exhibit 5-E, at the first column there at

Herman P. Meissner—for Plaintiff—Direct

the bottom of the page around Line 53, 52, does that section in there tell you anything about going towards shorter cycles? A. Yes.

I will read from those lines. "However, the adsorption, desorption time cannot usually be reduced below the lower limit stated, since part of the carrier gas for the impurities, which is generally produced in the pure state or worked up"—now this carrier gas is from another part of the plant therefor—"is adsorbed at the same time and this part is displaced in the subsequent washing period by washing gas, admixed to this and is therefore lost."

Q. What does the '150 patent teach you here with regard to short cycles? A. Well, it says that short cycles, really short cycles are not desirable. They are disadvantageous.

Q. And would you explain? A. Because of product loss.

Q. Would you explain to the Court why they are disadvantageous with regard to the operation disclosed in the '150 patent? A. Because as stated in the patent here there is concern about a loss of the purge gas. It reads, you see:

.

[207] gas"?

Q. No. Before that. A. I beg your pardon. "to which the effluent treated gases yield their heat." The accumulator has had these gases yield their heat to the effluent treated gases. Therefore, it indicates that the purified gases are carrying heat away from this system that they have been increased in temperature.

Q. Now would you please refer to Page 2, the second right hand column at the very bottom, and tell me if there is anything regarding the thermal reaction as described there, the last line, Line 129. A. Yes. It states:

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“If the available quantity of washing gas is not sufficient, heating by a few degrees will suffice to achieve the desired result with smaller quantities of washing gas.”

He clearly recognizes the advantages, of course, of heating the washing gas. He goes on to say:

“An increase in the mean temperature level of the partial discharge by at least 3 degrees Centigrade”—which is, incidentally, about 5 degrees Fahrenheit—“relatively to the additional charging operation is sufficient to halve the ratio of the volume of washing gas to volume of untreated gas.”

In other words, again we find that regeneration with heated gas is recognized as a real possibility. Really in this patent we see discussed two of the traditional methods [208] for regeneration of adsorber beds after they have picked up a key component.

One of them, as we have seen earlier, is to pass through the beds relatively large volumes of purge gas. The purge gas volumes being in excess, being greater than the volumes of gases generated by the device itself in the adsorber part of the system.

Another way, then, to heat these gases is to pass heated gases through the bed on desorption, as indicated here.

Q. Is there any disclosure in this patent of achieving desorption by using the heat of adsorption within the bed without the use of any external heat? A. No.

Mr. McCormick: Objection, your Honor. I think the witness should testify. That's too leading.

Herman P. Meissner—for Plaintiff—Direct

The Court: The answer may stand.

Mr. Huettner: Mr. McCormick, may we stipulate that the inventor of the British '150 patent, although it does not appear on the face, is a man by the name of Mr. Kahle?

Mr. McCormick: Yes. Your Exhibit 5-E is the same as No. 26 in the binder of prior art patents which I have produced under the Exhibit No. M-5.

The Court: That doesn't contain the name?

Mr. Huettner: No, it does not, your Honor.

* * * * *

[218] (Plaintiff's Exhibit 5-B: German Patent 871.886, marked full exhibit.)

By Mr. Huettner:

Q. Do you have German Patent '886, Exhibit 5-B before you, Dr. Meissner? A. Yes, sir, I do.

Q. Who is the inventor of the Exhibit 5-B? A. The inventor of this patent is again Dr. Kahle, the same inventor that we found on the earlier two patents discussed.

Q. Have you studied the disclosure of this patent? A. Yes, sir, I have.

Q. What kind of a process is disclosed in Exhibit 5-B, the German Patent '886? A. This patent is of a, what shall I say, more general nature than the earlier ones that we talked about.

It refers specifically to an adsorption of materials of key components from gases in a single bed and it refers further to the control of cycle times in a single bed and covers, in Claim 1 for example, the breakthrough time

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which you will remember is that time at which the key component begins to emerge from the far end of the reaction zone.

This patent then talks about the removal of a key component from a gas stream flowing through a bed of adsorbents and stopping the adsorption part of the cycle short of breakthrough, [219] short of the point where the loading of the purge gas—I beg your pardon—where the loading of the adsorbable gas begins to increase and short then of the other half of the cycle, short then of the time when this key component, the desorbable component begins to diminish in the purge gas.

Q. Dr. Meissner, what kind of cycles does this patent teach you? A. Cycle times are not too specifically defined. But cycle times in terms of the specifications are such that a relatively large percentage of the adsorption capacity of the bed is utilized. That is to say again about 14 per cent of the bed loading is attained in a single adsorption cycle. The bed is made to pick up about 14 per cent more of the key component from the beginning to the end of the adsorption cycle.

We encountered this No. 14 before when English Patent '150 was discussed.

By the Court: /

Q. Now, when you say 14 per cent of the key component you mean leaving 86 per cent of the key component in it? A. No. The bed itself picks up 14 per cent incrementally of the key component in comparison with what the bed could pick up if it were totally saturated.

Herman P. Meissner—for Plaintiff—Direct

Q. When you say "pick up" you don't mean it in the sense of extract 14 per cent of the key component? A. No, indeed.

[220] Q. You mean it utilizes 14 per cent of the bed? A. Of the capacity of the bed to pick up components.

Q. All right. A. And in the bed, of course, the gas in passing through the bed surrenders in the reaction zone a very large proportion of its key component to the active zone of the bed.

By Mr. Huettner:

Q. Dr. Meissner, would you refer to the fourth page of the translation and the first full paragraph on that page and tell me how one determines cycle time? A. Well, let me read.

"In the utilization of this invention, it is not critical that the point of switchover be precisely determined. It is, on the contrary, recommended to analyze for some time the purge gas and wait until its content of desorbed component diminishes and then to establish appropriate desorption time, respectively cycling time of the two adsorbers, eventually with some shortening or lengthening of the time interval for incomplete desorption, depending whether one looks for complete adsorption or small cycling losses."

Q. What does that paragraph mean to you, Dr. Meissner? A. Well, in passing this location, of course, to the cycle time, to the time at which the bed is switched from desorption to adsorption from adsorption to desorption.

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And it recommends that operations be carried out in such a way that [221] the purge gas be analyzed during the desorption cycle and at such time when the concentration of the key component being swept out in the purge gas starts to diminish.

You see during the early stages of desorption the purge gas carries the key component being desorbed as a vapor at constant concentration.

The Court: I understand. This is when you keep checking to see that you get just exactly what you want?

The Witness: You keep checking and you establish the time at which you stop and then back off perhaps a little, back off a little from that time. As it says here, "Eventually with some shortening or lengthening of the time interval."

Q. Dr. Meissner, does this paragraph give you any indication as to the thermal reactions that are taking place in this process? A. Yes. Under operations of this sort, of course, the reaction zone will have traveled a great distance through the bed. In so traveling the reaction zone will have caused the heat to travel a long distance within the bed, away from its birth place, and indeed will with time, since the wave of heat outstrips the reaction zone as the reaction zone travels out through this bed.

So as the process provides there will be heat carried [222] out of this bed in the adsorption, in the gas undergoing adsorption.

Q. What happens to that heat that is carried out of the

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bed? A. And in being carried out of the bed, of course, that heat is lost to the bed.

Q. Can it be used? A. It is not available for desorption in the desorption part of the cycle.

In other words, this description really stipulates long cycle times relative to that critical factor; namely, the recovery of desorption heat.

Q. Dr. Meissner, does the '886 German Patent disclose any purge volumes, of purge gas volumes? A. It really does, although not directly stated.

But the thinking in this paper is illustrated by these diagrams that are presented only in the German part of this patent. I think that if you turn to the end of the German version of the patent you will see diagrams and the diagram on the lower right, the diagram called Abb. 5 shows in that central curved section between the words "desortionsende" and "desortionsanfang," defined between those two words by those vertical lines, that represents the duration, the history of an adsorption cycle, adsorption half cycle and a desorption half cycle.

[223] The word "desortionsende" means the end of the desorption period. The word "desortionsanfang" underneath there means the beginning of the desorption period.

Now then a total saturation of this bed would result in this figure being completely crosshatched. The crosshatched region would represent really the water traffic that would be involved in an operation.

Notice, I say crosshatched, the vertical lines. So it is interesting again that the area between those two lines turns out to be about 14 per cent of the total, if it is measured.

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Now, these diagrams, to a degree, surely are schematic. Nevertheless, the fact that 14 per cent is about what that area turns out to be, that area which involves those vertical lines indicates then that the cycle times here are chosen so that for this bed—and it was this bed of whatever the dimensions are—they had a 14 per cent variation in the moisture content of the solid; not the gas, of course, but in the solid.

They operated long enough so that that reaction zone moved upward in the adsorption vessel a distance so that an increment of 14 per cent in total water content of the bed occurred. Fourteen per cent, again as compared with the much smaller percentage of the Skarstrom invention.

In this 14 per cent travel of the reaction zone again [224] I would like to make the point that the heat then generated within the reaction zone is swept, is caused to travel, a good deal of it, out of the desorption zone away from the place where it was born. This is caused because of the relative length of distance of travel of this bed. The heat-wave going up through the upper reaches of the bed is, of course, a source of loss of heat from the desorption zone.

In fact, if we look at this diagram carefully it indicates that the desorption zone—that being the zone in which the gas is exchanging the key component with the solid—that desorption zone goes very close to the top of the bed.

Please note that the Y axis on this diagram is called "Schütthöhe," the word being reported once in the first picture up on the left hand top of this sheet, you see. "Schütthöhe" is the Y axis and that means then the height of the bed, really, the height of the poured adsorbent bed.

And the X axis to the right is the degree of loading.

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And the degree of loading referred to is the loading of the solid with water, the percentage picking up of the solid in any given position.

By Mr. Huettner:

Q. Dr. Meissner, would you refer to Page 2, Paragraph a.

A. Yes, sir.

Q. And tell me what kind of purge volume is used there.

A. The purge gas volumes referred to in this patent [225] range from 1, 2 or 3 times the raw gas volume. I am reading on the fourth line under Paragraph a.

Q. Does that tell you anything about the kind of purge gas that is used? A. It does not there.

It does later in this paragraph. Down below, about half way down, the words start:

“With sufficiently large pressure differential, a part of the fractionation product in question, which is not needed for the purging of the adsorber, can then even be obtained pure.”

The word fractionation product as it is used here and as it is used in the German version indicates that the fractionation product is derived from the rest of the plant.

Q. What do you mean by the rest of the plant? A. Presumably the liquid air plant and whatever other plant equipment is involved to which the adsorber beds that we are discussing here are supplying gas which has been made free of the key component that we are trying to remove.

Q. You mean product, don't you? A. The product, thank you, yes.

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Q. What does this patent teach you with regard to purge gas and product? A. So it teaches us then that in order to operate this patent large purge volumes are used, again purge volumes which [226] are equal to or in excess of the feed volumes, the raw gas feed volumes used in this system.

Unlike Skarstrom, the purge gas does not come from the product gas made within the process itself, but instead the product gas comes from another part.

Q. The what? A. The purge gas, thank you, the purge gas comes from another part of the plant.

Evidently these people again did not—Kahle again did not contemplate here the use of a purge generated internally in the process. And in this sense then differs from Skarstrom.

Q. Dr. Meissner, would you refer to the paragraph at the bottom of Page 2 and tell me if this patent teaches you any method in obtaining high purity in your product. A. Yes. A method of obtaining high purity as described in this section says that:

“It is sufficient in this invention to undertake a stronger desorption of both adsorbers by means of a larger purge gas volume or a higher temperature one time after a large number of cycles. How often this additional desorption is required depends on the respective operating conditions.”

This means, then—perhaps it would be helpful to read the next sentence.

“However, there hardly should be a case in which such [227] additional desorption is required more fre-

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quently than after a few hundred cycles, this means, therefore, that such additional desorption in the exceptional cases is only required at intervals of several days or weeks."

In other words, in this operation the reaction zone does not oscillate backward and forward necessarily within the bed, but has a habit of traveling toward the top or toward the bottom of the bed. The bed must be purged from time to time in order to prepare it—

Q. Purged in what manner, Dr. Meissner? A. Well, it can be unloaded.

Q. We've been speaking of purge. A. Let me read again. Purged in this case by using a larger volume than usual of purge gas or by using a higher temperature.

Q. Why would one want to do either one of those in an operation? A. In order either to sweep out impurities which might have accidentally accumulated in the system, but more important and more frequently in order to reposition the bed and make sure that it will operate continuously.

Q. Why would you have to reposition it? What would cause it to get out of position? A. Because in operations which are not in proper balance resulting from the fact that heat, for example, is lost from [228] the system, the reaction zone in the bed whilst oscillating backward and forward will drift in the bed toward one end or another.

Q. And if it drifts toward the product end of the bed what can happen? A. Well, if it drifts toward the product end of the bed then, of course, the key component which

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is being adsorbed will ultimately find its way into the tail gas, into the product.

Q. What is that called, Dr. Meissner? A. The product gas.

Q. When it finds— A. This is breakthrough. This is breakthrough.

Mr. Huettner: I would like to mark as Exhibit 5-C German Patent No. 882,541.

The Court: Very well.

Mr. McCormick: Your Honor, that's No. 20 in the binder.

The Court: All right.

(Plaintiff's Exhibit 5-C: German Patent 882,541 marked full exhibit.)

By Mr. Huettner:

Q. Dr. Meissner, do you have the German Patent '541 before you? A. Yes, sir.

[229] Q. Who is the patentee of this patent? A. Dr. Kahle is again the patentee. He is again the inventor.

Q. The same patentee that we've been discussing in our previous four patents? A. Yes, sir.

Q. Have you had the opportunity to study the Kahle Patent '541, Exhibit 5-C? A. I have.

Q. And to what does the disclosure relate to in the Kahle '541? A. Kahle '541 describes a process given the name of Sorbogen I by the inventor.

Q. Would you spell that? A. Spelled capital S-o-r-b-o-g-e-n. The derivation of this title I am not sure of.

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Sorbogen is not a scientific term regularly used. It is a coined term, I believe, to designate the process that we are going to talk about here.

Q. Would you talk about the Sorbogen I process? A. And the Sorbogen I process is perhaps mostly understood by again looking at the figures associated with this patent; namely, Figures 1 and 2, which respectively show two versions, two alternate versions of this invention.

Q. Are those figures attached to the back of the German patent? [230] A. Yes, sir, they are.

Q. Would you proceed, Dr. Meissner, to describe Figure 1. A. In Figure 1 we see an apparatus through which gas is flowing, a feed gas from which material is to be desorbed enters at the point 11, whereas purge gas enters at point 9.

There are provided here in this figure two beds, Nos. 1 and 2, with the slant crosshatched region in each representing an adsorbent material packing. On top of and below each of these beds is a checkerbrick—I mean a crosshatched checkerbrick sketch here which indicates a regenerative type heat exchanger.

Q. Would you explain to the Court what that is? A. Yes. A way of visualizing such heat exchangers—and I'm talking now about those regions in the two vessels designated by Nos. 3, 7, 8 and 4—

The Court: Wait a minute.

The Witness: I'm reading on Figure 1.

The Court: Yes. Those are the heat exchangers, you say?

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The Witness: Yes, sir. Those are the heat exchangers of a particular variety. They are regenerators and could be imagined as follows:

They might be made of spheres, large spheres, let's say an inch in diameter of a suitable inert [231] material which lies below and above each of these two beds.

By Mr. Huettner:

Q. Are they adsorbers? A. They are not adsorbers. They are heat carriers.

Q. Dr. Meissner, would you trace the flow of the process in Figure 1 of the Kahle patent '541. A. Yes.

Gas carrying a key component enters at 11, passes through the reversible valve 6, into the chamber on the right called chamber vessel No. 2, travels in the direction of the solid arrow written into the middle of chamber No. 2. The solid arrow in that chamber indicates the direction of gas flow.

So the gas enters at 11, goes through 6 and on up through 4 into the bed No. 2. Then on up further into 8.

Q. What happens at 8? A. And on the adsorption cycle gas in chamber No. 2 has been heated because there has been heat evolved. And as that gas gets into 8 it surrenders its heat to the checkerbrick, to the heat exchange medium, whatever it may be that lies in the top part of that exchanger comprising 8.

From there on then the gas then, in passing through 8, has cooled off again a trifle and it passes on over through the reversing valve No. 5 and out at 10.

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[232] The Court: That is the finished product?

The Witness: Yes, sir. That's the product from which the key component has now been removed.

A. (Continuing) Now, simultaneous with this operation purge gas enters this system through pipe 9 and then on down through the vessel on the left, going through first the heat exchanger 7, then through the bed of adsorbent at 1, and then the heat exchanger No. 3, then out at the bottom, leaving the system at point 12.

Operating under this condition, the direction of flow of the purge gas through vessel 1 is indicated by the vertical solid arrow pointing downward. The solid arrow on the right is upward, the solid on the bottom and the bottom ones show the reversal.

During the flow of gas through chamber 1 in the direction of the solid arrow the gas entering chamber 7 is heated from heat stored there from the preceding cycle, then passes on down through the adsorbent in chamber 1, where it strips, it removes desorbed material from that adsorbent in No. 1, and in the process of this cools off and then passes down through this bed into heat exchanger 3 where the gas is rewarmed. And the temperature of the heat, the warmth—

By the Court:

Q. What supplies the warmth to 3? A. If you look at the gas entering the chamber No. 2 [233] on the right—or I should say chamber 4, this gas entering at 11, which is at ambient temperature, enters 4 and finding this heat exchanger material chilled from the preceding cycle sur-

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renders some heat to that material, but itself the gas in passing through 4 becomes chilled.

Q. I'm talking about 3. I understood you to say that that was warm, it warmed the gas when it went through 3? A. Yes, sir.

Q. How would that happen? A. And the derivation of the warmth in 3 was that on the reverse cycle, if we can imagine the other half cycle, you see, when—

By Mr. Huettner:

Q. Which arrow are you talking about, Dr. Meissner?

A. I'm talking about the dotted arrow now.

Q. On the left bed? A. On exchanger No. 1 on the left. When the gas now travels in this direction it finds that in passing through 3—

By the Court:

Q. When it passed through 4 in that direction it got cooled off? A. Yes, sir.

Q. Now when it passes through 3 in that direction why wouldn't it get cooled off? [234] A. It does.

Q. And it's the heat then that cools off is retained by the heat exchanger 3? A. Yes, sir. It cools off, that's correct.

The Court: All right.

By Mr. Huettner:

Q. Dr. Meissner, does the '541 patent tell you what kind of purge gas one should use to desorb in this operation?

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A. Well, the purge gas again comes from an outside source. And under those circumstances, again Kahle appears to be thinking in terms of a liquid air plant and a liquid air installation—a liquid air plant in which purge gas is available from some source in the plant.

Q. And what is that purge gas? A. Nitrogen.

Q. I refer you to Page 5, Dr. Meissner, about the fifth line. A. Yes. There it is. On the fifth line:

“Concurrently, dry purge gas flows constantly through 9, for example, pressureless nitrogen.”

Q. Now, is that product purged? Is the nitrogen product purged? A. It is not purged from this adsorber system. It is not.

It is gas which is obtained from elsewhere within this plant, rather than from the system itself.

[235] Q. Dr. Meissner, what is the thermal reaction that takes place in the Kahle patent in the beds, within the Kahle patent '541, Exhibit 5-C? A. Well, whilst the key component is being adsorbed in these beds, while the gas, for example, in the bed on the right is surrendering its key component, CO_2 , to whatever the adsorbent is in this bed, the reaction zone rises toward the top of the bed in the direction of the solid arrow.

Simultaneously, of course, heat is evolved in the reaction zone and this heat is washed upward by the gas traveling again through the adsorbent bed which tends to be washed away from its birth place, and this heat traveling out of the top of the adsorbent bed is captured in the heat exchanger 8.

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And so during the adsorption cycle 8 is heating, whilst simultaneously 7 in the desorption cycle—of course, the gas from 9 is passing down through 7, simultaneously is picking up this heat, is being warmed by the exchanger 7.

The Court: Why?

The Witness: Because 7 was heated in the previous half cycle by the gas rising in the adsorption cycle.

Looking at the bed on the right, let me chase that through the two cycle stages.

The Court: Okay. I've got it.

The Witness: Okay.

[236] *By Mr. Huettner:*

Q. Referring to Page 1 of the translation, at the bottom of that page, does the patent teach you what the temperature of the purge gas should be? A. "The heat quantity of the adsorption, per this invention, is utilized again for the following desorption in that one arranges for a heat exchange at the exit of the purified and through the released adsorption heat heated gas, so that the purge gas which is to be used for the desorption will be preheated, while the heated through adsorption purified gas is cooled down and in exchange with the purge gas is again cooled."

That is a rather involved way of saying that the heat exchangers at the top and the bottom of the vessels 1 on the left and the right of Figure 1 are conserving heat and exchanging it backward and forward, whilst the gas passes first in one direction, then in another through those beds, depending upon whether it is an adsorption or a desorption cycle.

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Mr. Huettner: Your Honor, I would like to mark as Plaintiff's Exhibit 5-D German Patent No. 970,223 and the translation attached thereto, which was provided by the defendants. This is Tab 21 of Defendants' Exhibit M-5.

The Court: This is Kahle again, right?

Mr. Huettner: Yes, your Honor.

[237] (Plaintiff's Exhibit 5-D: German Patent 970,223, marked full exhibit.)

By Mr. Huettner:

Q. Dr. Meissner, have you had the opportunity to study the Kahle patent '223, Exhibit 5-D? A. Yes, sir.

Q. What process is described therein? A. I find that the process described therein is very similar indeed to the process described in English patent 677,150.

Mr. Huettner: Your Honor, that was the first patent, 5-E.

Q. Would you describe what the Exhibit 5-D shows, Dr. Meissner? And if we can avoid repetition. It's similar to the other, but we have to show what this particular patent shows. A. Yes, sir. As was the case with 677,150 British patent, this patent again relates to the removal of carbon dioxide from air for subsequent use of that air in an air liquefaction plant.

Purge gas for washing, or washing gas, is again used in the quantities as described in Patent No. '150; namely, in volumes equal to 3 to 4 times the volume of the feed. The derivation of the purge gas is again from the plant coming

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from some location outside the purification unit [238] that we had talked about.

Q. Is it product gas? A. It is not product gas. The purge is not.

Q. Would you refer to the top of Page 3 of the translation, the very top of the page, and tell me what the purge gas is? A. On Page 3?

Q. Of the translation. A. Yes. "As experiments showed"—

Q. This is the top, Patent '223. What does the first line on the top of Page 3 say? A. "Unneeded purge gas."

Q. What is unneeded purge gas? A. Well, the unneeded purge gas is gas which derived somewhere from outside the operation itself is not required for purge but is available for whatever other purposes might be important to the manufacturing establishment.

Q. Does Exhibit 5-D tell you anything about cycle times. And I refer you to Page 4. A. Yes. Starting on the bottom of Page 3:

"Whereby a switching cycle of between 5 and 30 minutes is utilized." Again a duplication of what was reported in English Patent '150.

Q. And what you have said concerning that is equally true here? [239] A. It is equally true of the English patent.

Q. Referring to Page 5, at the last paragraph, does that tell you something about the purge volume? A. Yes. I am reading now from the fourth line up from the bottom:

"A purge gas volume of 3 to 4 times that of raw gas volume is sufficient to unload the adsorbent at ambient temperature as well as at the same temperature."

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Q. And is that similar to the previous British patent?
A. That is similar to what we have discussed under the British patent. The two patents are parallel.

Q. And in the last line of Page 5, does that tell you anything about heating purge gas? A. It indicates that under those conditions of operation stated, namely again reading: "So that a constant purifying effect of better than 99 per cent is guaranteed permanently without that the purge gas has to be heated above the temperature of raw gas."

It does say, therefore, that the purge gas is heated under some conditions.

Q. And if one were to use less volume of purge gas than the 3 to 4 times would you refer to Page 7 and tell me if they give you any instructions? A. It would require again heating.

"Should there not be enough purge gas available, [240] then heating by a few degrees makes it possible under the given conditions to get away with still less purge gas. Halving the ratio of 3"—in other words, using a $1\frac{1}{2}$ ratio instead of a ratio of 3 of purge gas to feed.

Q. Dr. Meissner, what is the significance of heating purge gas? What does that do to the efficiency or whatever it is with regard to purge? A. Purge gas heating, of course, restores to the bed the heat which the bed in various ways has lost as being carried out of the bed in the adsorption cycle by the gas passing out of the bed.

Alternatively and in addition, of course, in a bed in which regeneration is occurring, if the adsorption part of the cycle has continued long enough—I've talked a fair amount about the fact that the heat is carried in good part away from—

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The Court: That has been explained several times. The question is what was the function of restoring heat to the bed or heat to the gas.

Mr. Huettnner: To the purge gas.

The Court: Yes.

What is the purpose of heating the purge gas?

The Witness: To bring back to the reaction zone that heat which it lost during the desorption stage of the cycle.

[241] *By Mr. Huettnner:*

Q. During what stages? A. During the adsorption stage of the cycle.

Q. Why is it important to bring back that heat? A. Because, of course, the heat requirements of desorption—

The Court: Desorption?

A. —exactly match the heat evolved during adsorption. Let me be a little more specific.

The Court: All right. You say they lose a little, so bring in a little?

The Witness: Yes. And it must be an equal quantity because, of course, when one pound of material is desorbed the heat requirements are exactly equal to those of adsorbing that quantity of material.

By the Court:

Q. The heat that is generated in one or the other is the same? A. Yes, sir.

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Q. Either in the gas or in the product being desorbed?
A. Yes. Although the place where the heat is generated, of course, is on the surface of the adsorbent in the reaction zone.

Q. And you need heat to desorb? [242] A. Yes, sir.

The Court: All right.

By Mr. Huettner:

Q. Dr. Meissner, is everything that you said concerning the British Patent '150 applicable to the German Patent '223, Exhibit 5-D? A. It is.

Mr. Huettner: Mr. McCormick, can we stipulate that the British Patent '150 is the corresponding British Patent for the German '223?

Mr. McCormick: We can stipulate that they are corresponding, but they are not precisely alike.

Mr. Huettner: Not precisely alike, no. But they are corresponding.

Mr. McCormick: There are differences.

The Court: You mean more than is lost in the translation?

Mr. McCormick: Yes.

The Court: All right.

Now we have covered the patents, have we?

Mr. Huettner: Yes, sir. We have one article to go.

The Court: Now, wait a minute. What language do we go to here?

Mr. Huettner: We still have a German article,

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[244]

AFTERNOON SESSION

Mr. Huettner: Your Honor, if I may, I would like to introduce into evidence as Exhibit 5-F an article by Kahle and the English translation thereof which has been provided by the defendants.

The Court: All right. Full exhibit.

(Plaintiff's Exhibit 5-F: Article by Kahle, marked full exhibit.)

By Mr. Huettner:

Q. Dr. Meissner, do you have the article that has been marked 5-F for Identification? A. Yes.

Q. The translation bearing the title, "The Reversible Adsorption As A Means For Precleaning and Fractionating of Gaseous Mixtures"? A. I do.

Q. You have that before you, Exhibit 5-F? A. I do.

Q. Do you have that before you? A. I do.

Q. Who is the author of this article? A. The author is Dr. Kahle, the same Dr. Kahle who was the inventor of the patents that we have been discussing this morning.

Q. And have you had the opportunity to read the article? [245] A. I have.

Q. Have you also read the German version? A. Yes, I have.

Q. Dr. Meissner, what kind of a process is described in the article, Plaintiff's Exhibit 5-F? A. The process described is the process that we earlier encountered under the name of Sorbogen I. Also described is a second process called Sorbogen II. The designations I and II indicate that the processes are different.

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Sorbogen I is essentially that which we encountered in Patent No. '541.

Q. Which is Exhibit 5-C. A. Sorbogen is then described extensively in this article. Sorbogen II differs from Sorbogen I in that as illustrated by Figure 7, Page 147 of the German article.

Q. Would you describe Figure 7 of the German article, Page 147? A. I will. There are presented in this figure two vessels, each containing a bed of adsorbent located midway in the vessel indicated by the crosshatched area, the tightly crosshatched area in the center.

On the ends of each bed are heat exchangers of the type that we encountered in Sorbogen I. The bed on the left in Figure 7, Page 147 of the German article, the vessel on the left contains then in the bottom region a bed of heat exchange [246] material and in the top bed of heat exchange material.

The adsorbent in the middle is separated from the heat exchanged exchanger beds by these pipes indicated by those zigzag lines. The top pipe is called heizung, and that means heating. The bottom zigzag line is called kuhling, and that means cooling.

In other words, there would be a coolant, such as chilled brine, which might be flowed through the pipes called kuhling. These pipes being located between the heat exchanger beds and the adsorbent beds as shown.

The heizung pipes, in turn, would carry an appropriate heating fluid such as is commonly used in industry.

Q. Dr. Meissner, in view of the article and the Figure 7 that you've been referring to, can you tell me what is the heat transfer system used in Sorbogen II? A. Sorbogen II

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then involves the transfer of heat to the gas entering and leaving each of the two adsorber beds heat transferred from a heat source outside the apparatus itself. The cooling fluid and the heating fluid must somehow be brought to proper temperature in appropriate apparatus.

Q. And would you tell me what happens to the heat balance within the beds, the adsorbent beds, in Sorbogen II?

A. In Sorbogen II the heat added in the top part of the bed is recovered, the heat added in the top part of the bed both in the heating coils—

[247] Q. My question, Dr. Meissner, was can you tell me about the heat condition inside the adsorbent beds of Sorbogen II? A. Yes. During the adsorption stage, such as might be indicated by the flow of gas shown by the vertical arrow on the left, the solid arrow on the left of the left hand vessel, raw gas then called rohgas down below enters the vessel on the left. That raw gas containing key component to be removed rises up through this system. The gas is first cooled in the bed of broken solids in the bottom of that vessel, then cooled further by the cooling coils, then in surrendering its key component to the bed of broken solids is heated, reaches the heating coils and washes the heat into the top of the bed.

Could I interrupt my talk for just a moment?

Yes.

Q. And how does the system operate on desorption? A. Could I interrupt? Could I add one thing?

During the adsorption cycle, of course, after the gas has been cooled downstairs by the cooling coil and passed through the bed, then of course that hot gas picks up heat from the heizung and goes into the top part of the bed,

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where it surrenders heat to the broken solids in the top part of the bed.

Leaves then through the pipe out of the top of the bed and proceeds to its place of utilization.

Q. And how is the adsorption bed desorbed? [248] A. In the bed on the right desorption proceeds by passing spulgas, gas which would be purge gas, to the top of that bed as indicated. This gas picks up heat in the heat exchanger and at the heating coils, then passes down through the adsorbent bed, through the bed of adsorbent, whereby the bed is dried by the hot gases.

Then the gas passes on down through the cooling coils through the cooled exchanger system in the bottom of that bed, through the cooled exchanger in the bottom of that bed, and then on out the bottom of the bed to whatever disposition is going to be made of that system.

Q. Is the heat of adsorption that is created in the bed, in the adsorbent bed during adsorption, used to desorb during the desorption cycle?

Mr. McCormick: Objection, your Honor. That sounds awfully leading to me.

The Court: Overruled.

A. It is, but only in part. Most of the heat for the desorption operation, or a good part of the heat for the desorption operation is provided by the heat supplied to the gas in the heating coils.

It is interesting that the difference—I beg your pardon. That would change the subject. I beg your pardon.

Q. What gas is used for spulgas? A. Which is purge gas. Purge gas comes from outside [249] this unit and is

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gas that can be nitrogen, named as nitrogen in these operations.

Q. Does Kahle use the product generated in adsorption for his desorption? A. He does not.

Q. Is there anything, Dr. Meissner, that you would like to say about the remainder of the article relating to Sorbogen I which we have discussed previously with regard to Exhibit 5-C? A. Sorbogen I operates as was described in the earlier patent. It is significant that on Page 5, for example, in the bottom paragraph an example is presented wherein a—

Q. Is this Page of the— A. This is Page 5 of the English translation, the bottom paragraph.

Q. Are your pages numbered? A. I beg your pardon. I have numbered them. It is the fifth page in from the beginning, which is headed at the top: "The Principle of Partial Loading and Partial Unloading."

In the paragraph at the bottom of the page an example is presented and the example describes an operation again involving a layer of one and a half meters of activated charcoal of a given size. The operation starts with a loading of 8 per cent saturation and then subsequently at the same—8 per cent saturation of the charcoal by the CO_2 at the beginning of [250] the adsorption cycle, loading the charcoal to a total of about 25 per cent of its saturation value at the end of the cycle, and then reversing.

This again then is an operation in which a rather long cycle is used. That is to say, the reaction zone is caused to move a significant distance up and down through the bed of adsorbent.

Herman P. Meissner—for Plaintiff—Direct

Q. What is the significance of that movement of the zone up and down in the bed? A. The movement of the zone up and down in the bed displaces heat—results in generation of heat of adsorption within this bed. That heat travels, of course, with the gas, and under these conditions would move out of the bed into the heat exchanger on the top of the bed.

It seems to me that Sorbogen II, then, introduces the principle of heating and of cooling. In other words, of bringing heat energy into and out of the system from an extraneous source, and again under these circumstances represents an operation which is apart from Skarstrom, for example.

Mr. Huettner: Your Honor, there are some footnotes at the end of the article on the translation. They refer to German patents, your Honor.

The first German patent that is footnoted there and discussed in the article is Exhibit 5-C. In other words, that German number there is the same [251] as Exhibit 5-C which we have already discussed.

The second footnote in the German patent is Exhibit 5-B.

The third footnote in German patent is Exhibit 5-B.

The fourth one was not introduced. We don't have that one.

The Court: All right.

By Mr. Huettner:

Q. Is there anything else you wanted to say about this, Dr. Meissner? A. By way of summary of this article, I think that the first sentence in the English translation on

Herman F. Meissner--for Plaintiff--Direct

Page 1 pretty well digests what this article is about. That sentence, of course, is a direct translation, a transliteration of the sentence in the first paragraph at the top of the German article. And it says, I'll read:

"On hand of diagrams and schematic layout examples, the principles as well as the equipment and process foundations for an approximate reversible gas cleaning and separation through adsorption for the purpose of extreme purification of the process gas are explained. The requisites are: combination of adsorbers with heat exchangers at both ends of the adsorbers, loading and unloading limitation of the adsorbers as well as counter flow unloading with adsorbate-free purge gases."

[252] I think the important words there are "combination of adsorbers with heat exchangers at both ends of the adsorbers."

Q. That is what is described through the article? A. Yes, sir.

Mr. Huettner: I would like to introduce into evidence Exhibit 6-B, which is a bulletin of Pall Trinity and the bulletin number is A309b.

(Plaintiff's Exhibit 6-B: Bulletin A309b of Pall Trinity, marked full exhibit.)

By Mr. Huettner:

Q. Dr. Meissner, do you have the Exhibit 6-B before you?

A. I do.

Herman P. Meissner—for Plaintiff—Direct

Q. And have you studied this exhibit? A. I have.

Q. Dr. Meissner, do you know what the Pall Trinity Corporation is? A. It is a corporation which manufactures, among other things, the driers illustrated in this pamphlet.

Mr. Huettner: Your Honor, we will have a subsequent witness who has been affiliated with Trinity.

Q. Dr. Meissner, would you tell us what kind of driers are illustrated in Exhibit 6-B? A. That is this bulletin, is it not, Mr. Huettner?

Q. Yes, it is. A. Here are illustrated the Type A Heat Reactivated [253] Desiccant Driers." That term means a drier, an adsorbent bed drier, a drier consisting of adsorbent beds which beds are directly heated during regeneration, during desorption, by heating surfaces immersed within the adsorbent.

The Court: Are you referring to the one with these fins on the back page?

The Witness: Yes, sir. This figure illustrates the disposition of fins within an adsorber vessel of this type.

Notice that the fins extend more or less radially from the center outward toward the wall, leaving relatively narrow spaces between neighboring fins. Those narrow spaces or slots between neighboring fins are then filled with the adsorbent during the operation of this drier.

Herman P. Meissner—for Plaintiff—Direct

The fins, of course, are not energized during adsorption, but during desorption the fins are heated by electrical resistances within those fins.

The Court: You mean during desorption?

The Witness: During desorption, when heat is required by the solid to release its moisture. And this heat then serves to expedite to allow the desorption to take place.

The Court: All right. That's that one?

Mr. Huettner: Just one other point.

[254] Q. Dr. Meissner, on the same page, up on the very top of the article, how also is heat lost by this device? A. Yes. During adsorption, partial cooling—as it says here.

Q. Where are you reading from? A. At the top of the page on which this figure of the finned vessel appears, the second line. "Partial cooling is provided by radiation and convection." That is, radiation and convection from, then, the outer surfaces of this chamber of this vessel to the surroundings.

Q. Dr.— A. And—

Q. I'm sorry. Continue. A. I was going to say this vessel has an eight hour N.E.M.A. cycle time. N.E.M.A. is a name which stands for National Electrical Manufacturing Association, I believe.

Q. Now also, Dr. Meissner, would you turn to Table V and tell me if other N.E.M.A. cycles are also recommended?

A. Yes. There are, of course, for units of different sizes different N.E.M.A. cycles and they go twelve hours, sixteen hours, twenty-four hours.

Herman P. Meissner—for Plaintiff—Direct

Q. And a cycle being what, Dr. Meissner? A. Adsorption phase and a desorption phase.

Q. What is the cycle time of the Skarstrom invention? A. Well, the Skarstrom invention involves times which [255] are measured not in hours, of course, but in minutes. Indeed three minutes plus three minutes. Three minutes on, three minutes off, as a typical example.

There are units, of course, that work on a faster cycle, on a briefer cycle than that.

Q. Dr. Meissner, would you kindly turn to the patent in suit, which is Plaintiff's Exhibit 1, to Claim 9 of the patent in suit. A. I have it here.

Q. Dr. Meissner, have you had a chart prepared under your instruction to assist in the reading of the claims of the patent in suit? A. I have. That chart is here exhibited on the easel.

Q. And what does that chart show, Dr. Meissner? A. That chart shows all of the parts presented in Exhibit 2 of the patent. There are these differences: that the numbers used for identifying various conduits, vessels, valves that were presented in Figure 1 of the patent are here replaced in large part by the terms used to designate these numbers.

Mr. Huettnner: I would like to mark into evidence Exhibit 3-A. Dr. Meissner will use it in his following discussion of the claim of Claims 9 and 12.

The Court: May be marked.

(Plaintiff's Exhibit 3-A: Chart, marked full

* * * * *

Herman P. Meissner—for Plaintiff—Direct

[274] adsorbent at said one end of said first bed.”

Equilibrium here—

Q. Would you explain what equilibrium there means?

A. The equilibrium at the bottom of the first bed means that there is no further exchange of moisture between gas and solid because the solid has picked up all the moisture that it can. It has been bathed by the wet gas, reaction zone, has passed on through. No further exchange.

The Court: Forgive me, but which one are you on?

The Witness: Claim 34.

By Mr. Huettner:

Q. Maybe if you would just read that again and continue? A. “Process as defined by Claim 13 wherein the time of each cycle is for a time period so that substantial equilibrium exists between the moisture in the feed stream and on the adsorbent at said one end of said first bed, and that substantial equilibrium exists between the moisture in the gas and on the adsorbent at said other end of said second bed.”

In other words, there is then an equilibrium in this bed and also in this bed.

Q. Dr. Meissner, have you had any trouble with the language of any of the claims that are in suit? A. No, sir, I have not.

Q. Dr. Meissner, do you have a statement as to what you consider a general description of the Skarstrom invention? [275] A. I do. I would like to read from that statement, if I may.

Herman P. Meissner—for Plaintiff—Direct

The Court: What is this, something you drafted?

The Witness: I have not drafted it, but I am in complete agreement with it.

It was prepared by Professor Gilliland. I have been over it with him carefully before his death and I feel that this is a good statement.

Mr. McCormick: I would like to see the statement, your Honor, before voicing any objection or not.

The Court: All right.

Mr. Huettnner: In the meantime, your Honor, I would like to mark as Exhibit 13 a stipulation entered into by the parties concerning infringement of Claims 9, 12, 14, 16, 17, 24 and 34 if the claims are held valid.

The Court: All right.

(Plaintiff's Exhibit 13: Stipulation by parties, marked full exhibit.)

Mr. Huettnner: I would like to mark into evidence as Plaintiff's Exhibit 11 a document signed under oath by an officer of the defendant company which is in response to request to admissions under Rule 36.

The Court: May be marked full exhibit.

[276] (Plaintiff's Exhibit 11: Document, marked full exhibit.)

Mr. McCormick: May it please the Court, am I interrupting something now?

The Court: I don't know. You seem to have found a pause somewhere. So go ahead.

Herman P. Meissner—for Plaintiff—Direct

Mr. McCormick: I think I should object to this, your Honor. I think the witness can testify without making this statement because it apparently is a statement of Dr. Gilliland and is argumentative.

The Court: Well, we will allow you to cross-examine.

Are we ready for it?

Mr. Huettner: I would like to mark it as Exhibit 16.

The Court: What is that?

Mr. Huettner: This is the statement that we have just discussed.

The Court: The statement of Dr. Meissner.

(Plaintiff's Exhibit 16: Statement, marked full exhibit.)

By Mr. Huettner:

Q. Dr. Meissner, you have read Exhibit 16, which is entitled, "General Description of the Skarstrom Heaterless [277] Drier Invention"? A. I have.

Q. And are you in agreement with the statement? A. I am in agreement with it, yes, sir.

Q. And would you read the statement and supplement it with any descriptive matter that you feel essential at this particular point in view of all the testimony that we have already had? A. Yes, sir, I'll be glad to.

This is the general description of the heaterless drier invention.

"A completely self contained self regenerating"—

Herman P. Meissner—for Plaintiff—Direct

The Court: Well, we can read it. The question is do you have something to add to it by explanation, amplification or qualification?

A. The words "self regenerating" in the first line mean that the process requires no external heat. All of the heat needed is maintained within the system as we have discussed.

It is a gaseous fractionating process. That is to say gas, of course, is separated into fractions, water is removed from the gas in the embodiment of the invention that we are talking about.

The Court: I think, Professor, if you don't mind, since you adopt this statement and we have it and we can read it, if you limit yourself to answering [278] the question as to whether you have anything to add or anything you want to modify or correct in this statement? Otherwise, it is here.

The Witness: All right. I would not modify it further other than to say that it does produce a dry gas stream, of course, this device.

The Court: Very well.

By Mr. Huettner:

Q. Dr. Meissner, would you turn to Exhibit 11, which is the response to admissions to defendant Kahn? A. Yes, sir.

Q. Dr. Meissner, have you had an opportunity to review the response to admissions? A. I have.

Herman P. Meissner—for Plaintiff—Direct

Mr. Huettner: Your Honor, I might point out that the admissions were drafted with the claims in mind and it was requested that the defendant respond whether or not they manufactured, sold or used driers which incorporated the elements as laid out in the response to admissions, which is before you as Exhibit 11.

The answers with regard to Claims 9, 12, 14, 16, 17, 24 and 34 are all in the affirmative; in other words, they admitted all of the elements as set forth in the response.

* * * * *

[281] *By Mr. Huettner:*

Q. Dr. Meissner, would you refer to Claim 17 of the patent in suit, P-1. A. Claim 17, yes, sir.

Q. Would you read Claim 17—not Claim 13 that it depends upon—but just that part that appears under 17. A. “Operation as defined by Claim 13 wherein said beds are self-contained with respect to the transfer of heat.”

Q. And my colleagues were able to note your answer and they think it might have been ambiguous. Would you tell me what this claim means? A. This claim means that the heat evolved in a bed on an adsorption cycle remains within the bed available for reutilization and is reutilized in the subsequent desorption carried out in that bed.

Q. Dr. Meissner, have you studied the prior art cited by the defendants in their prior art Volume 26, pieces of prior art? A. Yes, sir, I have.

Q. Have you concluded what, in your opinion, was the most pertinent prior art? A. I have.

Herman P. Meissner—for Plaintiff—Cross

Q. What was that, Dr. Meissner? A. The most pertinent prior art were the patents that we have reviewed today.

[282] Q. And what patents were those, in general? A. Those were the Kahle patents that we talked about today.

Q. All of the Kahle patents that we discussed? A. All of the Kahle patents and, of course, the Kahle article.

Q. And you also discussed the Trinity Type A Drier? A. Yes, sir.

Q. Do you consider that also pertinent? A. I do not.

Mr. Huettner: Thank you.

Cross Examination by Mr. McCormick:

Q. Dr. Meissner, I believe at the outset of your testimony you had indicated that you had undertaken no work in separation of water vapor by adsorption prior to this assignment? A. That is correct.

Q. In January you started your work in this assignment, is that correct? A. Yes, sir.

Q. And at that time I believe you consulted with Dr. Gilliland and got into the case in that manner, is that correct? A. Yes, sir.

Q. Now, Doctor, my undergraduate discipline was in mechanical engineering. I think I have a fairly good grip [283] on the subject matter, but my physics and chemistry was, as you will understand, limited to college physics and just the freshman course in chemistry in college.

Based on your experience would you say that that would be enough to understand the subject matter of this patent? A. I certainly think that with effort and with references

Herman P. Meissner—for Plaintiff—Cross

and reading, if you chose to understand the subject matter of this patent you could and would.

The Court: Do you think that would intend to me, Doctor?

The Witness: Yes, sir, I certainly do.

The Court: All right.

By Mr. McCormick:

Q. Actually, Doctor, much of the gas law and chemical operations involved here are pretty well described, are they not, in common physics and chemistry books? A. Well, the gas laws are very well described in the texts on physical chemistry.

What was the other area that you mentioned?

Q. Well, I asked any chemistry involved here would also be pretty well described in chemical textbooks, is that correct? A. Not ordinary chemical textbooks. I think that these surface phenomena adsorption are probably covered not in undergraduate [284] texts on chemistry, but on books in the field of colloid chemistry, adsorption especially and the like.

Q. In undertaking this assignment for the plaintiff, Esso, what materials did you study? For this particular assignment. A. I understand.

In addition to considering the patents at issue here, first of all in reading them I had available to me the background on adsorption that I have developed through the years through teaching in the field of surface chemistry and surface phenomena, in the areas of catalysis which I talk about in my professional career.

Herman P. Meissner—for Plaintiff—Cross

I, however, also, of course, consulted current literature in the field.

Q. Does that complete your answer? A. Yes, sir.

Q. Did you study the file history of the patent in suit?

A. No, sir, I did not.

Mr. McCormick: The file history of the patent in suit, your Honor, is on the list of the defendants' exhibits and has been marked J-5.

The Court: All right. I have it.

No. 134 previously marked J-5, right, would be 134?

* * * * *

[304] The Court: That is, after you pass the reaction zone?

The Witness: Well, in the cycling of the system backward and forward on the reversal of each one of the beds, on the reversal of each cycle the upper region of each bed gets drier than it was in the preceding cycle. This is the material that is described graphically on I guess it is sheet 3 of the patent.

By the Court:

Q. How does it get drier? What gets drier? A. The bed.

Q. The bed gets drier? A. The bed material up here gets drier, above the reaction zone. This part of the bed gets drier because of the reversal of flow.

Q. On the reversal? A. Yes, sir, each time.

Q. What dries it? A. It is dried out by the increasingly dried gas that originates in the other bed and it is dried out by the gas which originates in the companion bed.

Herman P. Meissner—for Plaintiff—Cross

In an adsorption operation when a bed is started up especially, of course, when a system like this is started up the entire adsorbent is often wet because it has been standing [305] idly. This device probably has gotten pretty wet.

When the operation of the unit is first started dry air passes up through this unit, expands here and comes on down in this direction and cleans up this bed. It removes water vapor from this bed here in the blue region. But the amount of water vapor that it can remove in the first cycle, after all, is relatively small because this gas still contains some of the original water that was within the system because of its idle standby condition. The purge gas in the upper region of the bed I'm now saying—

Q. That carries a little water? A. That's right.

Q. But you are saying it picks up water as it goes back in the non-reaction area.

Get on the right side. On the reverse, now. A. Well, yes. And this gas now being dried, being drier than what is originally present in this bed.

Remember, this bed now is filled just as this thing would be standby with, let's say, surrounding air. Both beds are filled with surrounding air and contain some moisture. Now then, the purge gas from the left side comes over here. It is drier, of course.

Q. That only happens once on the first round, doesn't it?

A. It repeats indefinitely and is the reason—

Q. Why? How do you get more air in there after the [306] first round? It is sealed to the air, isn't it? A. Well, that's true, but the degree of drying, the degree of moisture loss that has occurred here is not yet very great. This bed

Herman P. Meissner—for Plaintiff—Cross

was originally in equilibrium with the original air that was in it.

Next it comes to be in equilibrium with the first slug of purge gas that we put in there.

Q. Did that produce a reaction up there at the top? A. Yes, sir. That will dry, that being dry gas.

Q. That will be reactionary then all the way to the top? A. That would dry out the top part of the bed and will, with time, dry out the whole internal region of this bed.

This is the way one explains the fact that, as we see here, in Figure 2 the product out of a Skarstrom device from startup goes—you see, on a daily basis it started here at about I would read it as 4,000 parts per million on the first day. Then after I guess one day's operation we have gotten down to 10 parts per million on a pretty steady basis, you see. We continue to reduce the moisture content with time, as the chart indicates, and we end up then here on the seventeenth day with one part per million.

Q. That doesn't measure the moisture in the bed. does it? That measures the moisture in the gas; that diagram?

A. But in view of the fact that there is equilibrium established between the solid and the gas in these upper [307] reaches, the gas leaving the bed must be in equilibrium with the solid and the moisture content of that solid in the top of the bed. If that bed gets drier the gas gets drier.

The thing that dries the gas is the bed and if it originally starts wet, as it normally does in startup, this kind of—what I call perhaps rather poorly—bootstrapping operation, this remarkable increasing performance efficiency with time is what happens in such an operation, as illustrated by Figures 2 and 3.

Herman P. Meissner—for Plaintiff—Cross

Q. Is this your answer to why you have such a long bed? I mean that's what we started with and then you said this was schematic. A. Yes.

Q. And now you say this forms a useful function? A. It does. Because the top part of the bed does the final cleanup of the gas.

If I'm interested in getting down to one part per million I've got to have a bed which is capable of being in equilibrium with one part per million. And at these extremely low moisture contents—

Q. Is there reaction there? A. Yes, sir.

Q. Well, now all these diagrams that are there, 4-A and 4-B, do not show a reaction zone up at the top where you say there is utilization of the— [308] A. It does a cleanup job here, sir. Most of the reaction—and I should say the difference between maybe—the change in the upper part of the bed, the cleaning part, may be of the order of magnitude of a couple of parts per million. But this is often a desirable sort of polishing.

Q. Can I then, I mean to put a period on this, assume that it is your view that the longer the bed the drier the gas will be? A. Within limits. Yes.

In other words, if you double bed length, sure, it's a little better. After that, why, it isn't going to make much incremental difference.

By Mr. McCormick:

Q. Did I understand your testimony properly when you said this reaction zone in here, does that embrace this one per cent of the bed? A. No. When I talked about one per cent of the bed, when I used the term one per cent—

Herman P. Meissner—for Plaintiff—Cross

I think I said less than one per cent. I think I phrased it this way: that the movement of the reaction zone, which is this zone down here where 99.9 per cent of the dehydration of the drying of the gas occurs, the movement of that part of that reaction zone is about one per cent.

In other words, each of these graded colors here, the movement of that, each of those colors is about one per [309] cent of the length of the bed for a unit such as we might have set up, such as that one is.

Q. So what you are saying is while the reaction zone may occupy 25 or 35 or 50 per cent of the bed, its movement is one per cent? A. Is extremely small, that's right.

Q. Up and down is one per cent? A. Yes, sir.

Q. I believe that the movement of the reaction zone, this one per cent movement, can be detected by measuring the temperature within the bed and at points along the bed, is that correct? A. It is very difficult to pick up the position of the bed itself by temperature measurements because of the fact that the gas passing through the bed is continually moving some of the heat, a small part of the heat at the outset—by the "bed" now I mean the reaction zone—into the relatively dry bed material immediately above the reaction zone.

So that the temperature rise, the places where temperatures rise, the heatwave will outpace these regions of where the primary reaction occurs.

The Court: Then how do you measure it if you don't measure it by heat?

The Witness: It is measured as follows: Knowing the moisture content of the entering gas here [310]

Herman P. Meissner—for Plaintiff—Cross

during adsorption, if there is a three minute cycle and if I know what the parts per million of water are down here, I know how much water is carried into the bed in, let us say, I can easily calculate pounds per cycle. Knowing the pounds per cycle carried into the bed and knowing that the loss of moisture out of the top of the bed is negligible, after all it's very small anyway, a few parts per million but it doesn't signify the moisture into the bottom of the bed, then all of it is caught in the bed in the first half of the cycle.

I know the weight of that water. I also know the weight of water which this bed would take on if it were saturated.

Now, knowing the weight of water which is taken on per cycle and the total amount of water which the bed could take on if it were totally saturated, I get as a direct result the distance that the reaction zone would move.

The Court: That is where the water is?

The Witness: Yes, sir. So that each one of these layers of color, for example, would move up in proportion to this one per cent.

In other words, we say that the movement of the bed is best calculated by a material balance.

[311] *By Mr. McCormick:*

Q. Did you make this calculation, Dr. Meissner? A. Yes, sir. I've made it on a number of cycles.

Q. With this apparatus here in the courtroom? A. Yes, sir.

Herman P. Meissner—for Plaintiff—Cross

Q. Can you illustrate with this apparatus now the calculation that convinces you that the travel of the zone is at one per cent or less? A. Yes, sir. Would you like me to put it on the board?

Q. Well, can you do it with the apparatus? A. Well, I get into trouble with mental arithmetic. I do have the calculations here.

Q. Well, as I understood it, you made this determination? A. Would you like me to tell you what I have done, just generally, in the course of the calculations and sketch them out? I would be glad to do that.

Q. I believe you told me that you did it with this apparatus? A. Yes, sir.

Q. And this had to be done, I take it, with observing it in operation, is that correct? A. Yes, sir.

Q. Then we can do this tomorrow? A. Yes, sir.

Q. Okay. Now, is it Dalton's law, Doctor, that says [312] something to the effect that one standard cubic foot of air at any pressure at the same temperature will retain the same amount of water vapor? A. Yes, that would be a way of saying it; yes, sir.

Q. Does Dalton's law come into play in the operation of this apparatus? A. In the sense that the perfect gas laws apply to all gas mixtures, yes, sir, it would come into the calculations, for example, that I will make for you tomorrow.

Q. Well, I'm certain those calculations will be more sophisticated than the one I have in mind for you right now. But let us assume the condition where you talked about using a wet air inlet pressure of 60 pounds per square inch

Herman P. Meissner—for Plaintiff—Cross

absolute and a purge outlet of 15 pounds per square inch absolute atmospheric pressure. A. Yes, sir.

Q. Now, using Dalton's law wouldn't that indicate to anyone having acquaintance with Dalton's law that in order to desorb the vessel that is being desorbed you would reduce the pressure no more than one-fourth of the starting pressure and thereby you would get a sufficient volume of gas for desorbing to completely desorb the vessel? A. May I think about the numbers that you used for a moment? I'll see if I can repeat them.

I think you said that you were going to have a pressure [313] here in the inlet of 60 pounds per square inch absolute and in the purge of 15 pounds per square inch absolute?

Q. Yes, sir. A. And you say having stipulated that then—

Q. And at the same temperature, of course. A. Of course. Agreed.

And then that this operation would result in steady state?

Q. Knowing that you wanted to do that wouldn't a person acquainted with Dalton's law then reduce the pressure or use one-fourth as a pressure reduction in order to have a sufficient volume of air over here to desorb that amount of water which was adsorbed? A. Well, in order to remove water brought in in the feed gas into an adsorption operation from the companion vessel undergoing desorption it is necessary not only to control pressures, but volumes.

I have, of course, under my control if I operate this system—

Q. The volume. A. —this valve and I must, of course, see to it that I not only adjust pressures, but volumes.

Herman P. Meissner—for Plaintiff—Cross

Certainly if I open this valve only, or adjust it so that it is opened only a trifling distance so that the flow here, let us say, would be a hundred cubic feet per minute [314] and this one a tenth of a cubic foot per minute, then with this pressure ratio, without going further, even with this pressure ratio but with this volume flow ratio, even without going further into the numbers I think we would agree that we would do no drying.

Q. But under the circumstances where you have 60 pounds per square inch absolute going in and 15 pounds per square inch absolute going out, you would adjust your flow so that the flow through here would be at least one-quarter of the flow in, is that correct? A. I'm not quite sure that I understand what you mean by flow of one-quarter of what goes in there.

Q. You would use at least one-quarter of the dry gas to purge? A. Yes. At least.

Q. Yes. You would actually use slightly more? A. Yes.

Q. I believe you said yesterday one point— A. 1.2. It could go up to 2, the ratio. It is not a desirable ratio, but it could go that high.

The Court: That is 1.2 of what?

The Witness: 1.2 is a volume ratio. If there are 100 cubic feet of gas per minute, let us say, entering here and if there are 120 cubic feet per minute of gas emerging here at atmospheric pressure, [315] then we have accomplished the 1.2 ratio, you see.

The Court: All right.

Mr. McCormick: Your Honor?

Herman P. Meissner—for Plaintiff—Cross

The Court: You mean you don't want to continue on till six tonight?

Mr. McCormick: If you insist. I don't want to.

The Court: Well, I won't put the burden of making that choice on you.

You may step down now, Doctor.

The Witness: Thank you.

(Witness excused.)

The Court: What sort of progress are we making, gentlemen?

Mr. McCormick: I will be finished with Dr. Meissner in the morning.

The Court: All right.

Adjourn court until tomorrow morning at 10:00 o'clock.

(Whereupon, court was adjourned.)

* * * * *

[321] A. Column 9, Line 52 and 53 where it reads, with respect to Figure 2:

"After one day's continuous operation cyclically"—

The Court: What line are you starting at, 52?

The Witness: I beg your pardon. I was starting on Line 50.

The Court: All right.

A. "After one day's continuous operation cyclically reversing the flow through the adsorbers to produce an on cycle and off cycle interval of three minutes for each ad-

Herman P. Meissner—for Plaintiff—Cross

sorber the moisture content of the effluent product stream," and so on.

The time, therefore, of three minutes for each adsorber defines the time for Figure 2.

Q. Well, this indicates the selection of three minutes as the cycle time? A. Yes, sir.

Q. The selection of cycle time will vary, will it not, for each installation and under different conditions? A. It will not necessarily vary for each installation or for different conditions always. But it can be different from one installation to the next.

Q. But the operator starting the rig in operation will not always select three minutes as the cycle time, is that correct? [322] A. That is correct.

Q. Now, yesterday afternoon you said that you had determined by calculation that in the Skarstrom process the reaction zone traveled back and forth, or oscillated, within one per cent or less of the length of the bed? A. Yes, sir.

Q. I believe you said that you made your calculations with reference to the operation of the model here in the courtroom as Exhibit 15, is that correct? A. I also made the calculations—

The Court: No.

Is that correct?

The Witness: Yes, sir, that is correct.

The Court: All right.

By Mr. McCormick:

Q. Now, is it said anywhere in the Skarstrom patent that the reaction zone travels one per cent or less of the bed length? A. No, sir.

Herman P. Meissner—for Plaintiff—Cross

Q. Does the Skarstrom patent say anywhere what percentage of the bed length that the reaction zone travels in? A. No, sir.

Q. Yesterday on Direct Examination you were somewhat critical of the prior Kahle process as described in German Patent 871,886.

If your Honor please, that's No. 19 in my

* * * * *

[326] the timer on the other drier is on a cycle time that provides for reaction zone travel of 14 per cent of the bed length.

Now, this is the hypothesis. You understand that? A. I understand.

Q. Have you an opinion as to whether one drier will produce drier air than the other? A. I have an opinion.

Q. What is your opinion? A. The drier on the—did you say one minute—one per cent travel will produce drier air than the drier on the 15 per cent travel; assuming, of course, as you stated I believe, that bed depth, gas velocities and so on, everything else—

Q. All conditions are equal. A. All conditions comparable.

Q. How much will be the difference? A. I don't know.

Q. Will it be a significant amount? A. It will, in my opinion, be significant.

Q. All right. What, in your opinion, is a significant amount? A. Now, this is my opinion. In my opinion, with a cycle length of 15 minutes, depending again upon the beds—

Q. Now we're talking about 15 per cent. A. I beg your pardon, 15 per cent.

Herman P. Meissner—for Plaintiff—Cross

[327] Q. We are talking about 14 per cent versus one per cent. A. 14 per cent.

It is possible that as much as even 30 per cent, 40 per cent of the water in the feed will leave in the product.

The Court: Will leave in, will be left in?

The Witness: Yes, sir.

By Mr. McCormick:

Q. With the 14 per cent.

Now, when you are moving, traveling in 14 per cent of the bed length, you have not reached saturation of that bed. You understand that, don't you? A. That is correct. I do.

Q. Now, you say 30 per cent, that there would be a 30 per cent difference. Can you put that in millionths of parts of water vapor compared to the air stream? A. Well, it depends on what the water content is of the feed stream. But let us assume that the feed air enters at, shall we say, 7,000 parts per million. Then we will have a couple of thousand parts per million possible in the exit gas.

Q. With which drier now? A. In the product gas.

Q. In which drier, the 14 per cent drier or the one per cent drier? A. The 14 per cent drier. On these grounds: That whilst the bed is not totally saturated, the breakthrough value will have been exceeded.

[328] In other words, it's possible to have an operation in which the bed is not saturated but the breakthrough criterion is, nevertheless, exceeded. This operation, of course, that I'm talking about is an operation in which

Herman P. Meissner—for Plaintiff—Cross

the purge being used is derived from a Skarstrom type operation.

Q. Yes. You can assume that. A. We are assuming in this question and my answer assumes that the purge quantity therefore being used in both cases is a purge quantity which was derived from the dry product from the first adsorber.

In other words, I interpret your question as meaning that we are operating a Skarstrom type system.

Q. Yes, sir. A. If the purge quantities had been larger than the feed, as in the Kahle example—

Q. No. We are talking about Skarstrom. Let's stay away from Kahle now. A. I wanted to be sure of that, that I am answering your question properly and in the assumptions.

The assumption that we have made then is the purge in this case represents—there is product withdrawn as well as purge from the bed in which adsorption is occurring and it is this purge and only this purge which is used for washing purposes.

Q. Yes, sir. We are assuming the Skarstrom process. [329] A. Okay.

Q. Now your answer has been you are reducing how many parts per million to what number?

The Court: 7,000 to 2,000; 7,000 parts per million assume will be reduced to a couple of thousand if the reaction zone travel is 14 per cent.

By Mr. McCormick:

Q. Is that your answer? A. Yes, sir. Could be. That was the answer I gave, yes sir, in this case.

Herman P. Meissner—for Plaintiff—Cross

The Court: As distinguished from how many parts per million if it is just one per cent?

The Witness: Under one per cent, sir, depending—
Mr. McCormick: One per cent?

The Court: Under one.

The Witness: Under one per cent I think is the way I've phrased it.

By Mr. McCormick:

Q. The question was one per cent, but let's take it under one per cent then. A. I beg your pardon. If it is under one per cent in a Skarstrom type operation then, of course, the moisture content of the product gas will fall to what we have observed here and what is recorded well under, let us say, 20 ppm, 20 parts per million down to 10, even under, depending upon how long that unit is operated.

* * * * *

[333] Q. And you have said that that condition prevails in Disclaimed Claim 1? A. Yes, it would be covered by Claim 1.

Q. Now then, would you please read accused Claim 12, the accused claim portion 12, the short part. And I wish you would read it for the record, please. A. Yes, sir.

"Process as defined by Claim 1 wherein the time of each cycle is for a time period so that the partial pressure of the key component in the gas phase at the discharge end of said second bed does not deviate substantially from the partial pressure of the key component in the gas phase at the inlet of said first bed."

Herman P. Meissner—for Plaintiff—Cross

Q. Isn't that the inherent result you said that will occur with the Skarstrom process as defined in Claim 1? A. Would you repeat that question, please?

Mr. McCormick: Would you please read it back.

(Question read back.)

A. Let me reread the claim when you say "isn't that the inherent result," to myself.

When the proper cycle time is chosen and the other circumstances of the operation of the Skarstrom invention are properly chosen, then the desired result is obtained; namely, the desired result stated here:

" . . . so that the partial pressure of the key com-

• • • • •

[339] During the evacuation period in the desorption step the pressure of the chlorine will, of course, fall and there will be no partial pressure in this system to speak of, since the evacuation process will, no doubt, sweep out most of the air first.

In other words, this system of regeneration described here for the chlorine-saturated bed involves a kind of operation which would not result in matching these words on Claim 12.

Q. You and Mr. Huettner have said that it is an important feature of the Skarstrom patent that no heaters or coolers or any heat exchange means is required? A. Yes, sir.

Q. And I ask that you look at Claim 12 of the Skarstrom patent and tell me whether it says that there are no

Herman P. Meissner—for Plaintiff—Cross

heaters present at all? A. I want to give a forthright answer. Claim 12 does not include heaters. Is that—

Q. Pardon me? A. Is that a fair answer? Claim 12 does not specify heaters or coolers.

Q. It does not specify that there are no heaters or coolers present, does it? A. That's right.

Q. It is absolutely silent on whether there is heat [340] exchange means at all, is it not? A. Claim 12, is, yes sir.

Q. Well, I suggest that this claim was intended to cover operation with heat exchange means as well as without because Skarstrom mentions the possibility of using heat exchangers.

I refer you to Column 7, Line 60 of the Skarstrom patent to Column 8, Line 12. You did not read that before your Direct Examination and I now ask that you read this for the record. A. I've gotten confused as to which you want me to read. Would you repeat that, please?

Q. From Column 7, Line 60 to Column 8, Line 12. That embraces one paragraph. A. "In the method contemplated, the initial gaseous mixture fed to the system should be a material which does not contain appreciable amounts of components which exhibit higher heats of condensation or adsorption than the key components, under the operation conditions presently contemplated by this invention and which are also strongly adsorbed by the adsorbents selective for such key components. Where components which have such characteristics are present in appreciable amounts, their adsorption tends unduly to raise the temperature of the adsorbing zone, and thereby to increase the vapor pressure of an adsorbed key component beyond

Herman P. Meissner—for Plaintiff—Cross

the condition at [341] which it may be satisfactorily retained or accepted by the adsorbent. Likewise, under such conditions, desorption of the components having those undesirable characteristics set forth above, tend unduly to lower the temperature of the desorbing zone beyond the condition at which the key component is readily given up by the adsorbent. To some extent, however, the effect of such strongly adsorbed components may be counteracted by provision of heat exchange means in the respective adsorption zones whereby the temperatures of the zones may be maintained at levels such as to permit effective adsorption and desorption of the key components. For example, the heat produced in an adsorption cycle in one zone may be utilized to counteract the cooling effect produced by the desorption cycle in the other zone."

Q. Doesn't that suggest to you that Skarstrom contemplates the use of heaters under some circumstances? A. Under these special circumstances.

Q. And you have said that Claim 12 is not limited to a process which is heaterless, have you not? A. I don't believe that that was my phrasing.

Q. Well, I'll pose it as a question. Is Claim 12 limited to a process which does not involve a heater?

Mr. Huettner: Your Honor, I object to this questioning.

Mr. McCormick is asking the witness to inter-

* * * * *

[347] low pressure unit is to the absolute pressure of the high pressure unit."

Herman P. Meissner—for Plaintiff—Cross

Q. Will that not occur as an inherent result in the Skarstrom process if the amount of water adsorbed is equal to the amount of water desorbed cycle by cycle? A. Yes, sir.

Q. I believe we discussed a circumstance like this yesterday when I inquired about Dalton's law. As I understand the application of Dalton's law, that if you were going to have an inlet wet gas stream of 60 pounds per square inch absolute and you were going to have the purge outlet stream dumped into atmosphere at 15 pounds per square inch absolute there would be a ratio of 1 to 4, would there not? A. Yes.

Q. And knowing Dalton's law you would then adjust the volume of flow of the part of the primary effluent that you were going to use as the purge gas to be at least equal to one-fourth of the flow of the primary effluent, would you not? I said to at least one-fourth. A. To at least one-fourth. In other words, yes sir. This depends, of course, upon operating pressures and the like. The precise volume ratio that is chosen depends upon conditions.

The Court: Well, we are assuming that these are accurate conditions.

[348] *By Mr. McCormick:*

Q. We are referring to the Skarstrom rig now. A. Okay. That the purge flow is great enough so that it can, in fact, carry out the water.

Q. Yesterday afternoon I believe you said that if we reversed the flow through the adsorbing bed before that adsorbing bed reached complete saturation the inherent

Herman P. Meissner—for Plaintiff—Cross

result would be that equilibrium would exist between the feed stream and the inlet end of the adsorbing bed and equilibrium would exist between the purge stream and the exit end of the desorbing bed, did you not? A. Yes, sir.

Q. Will you now please read Claim 34 for the record?

A. "Process as defined by Claim 13 wherein the time of each cycle is for a time period so that substantial equilibrium exists between the moisture in the feed stream and on the adsorbent at said one end of said first bed, and that substantial equilibrium exists between the moisture in the gas and on the adsorbent at said other end of said second bed."

Q. Then that which is said in Claim 34 occurs as an inherent result of that which is stated in disclaimed Claim 13 where we have the marginal note "flow control limitation A-1," does it not? A. Yes, sir. I have no such marginal note, but—

Q. I am referring here.

* * * * *

[351] Q. Yes, sir. A. Yes, sir. I have it.

Q. I ask that you read from Page 2, the first sentence in Paragraph a of the translation. A. "If during ad- and desorption the same and approximate ambient temperatures are being utilized, then it is sufficient if the purge gas volume is one, two or three times the raw gas volume."

Q. Does the word "ambient" in the German translation mean anything different to you as used there than it does as used in accused Claim 16? A. It means the same thing.

Herman P. Meissner—for Plaintiff—Cross

Q. Now let us go to accused Claim 17. Would you read that for the record? A. "Operation as defined by Claim 13 wherein said beds are self contained with respect to the transfer of heat."

Q. What does that mean to you? A. That the heat generated in the adsorption part of this cycle within the bed remains within the bed and close to the—mostly within the adsorption zone—the remainder having been washed a trifle out of the adsorption zone in the upper parts of the bed and this heat is reutilized within the bed in the desorption step.

Q. Doesn't that mean about the same thing to you that Claim 16 does; that the operation goes on so that the tempera-

.

[354] A-1 occurs in both of them, and I don't ask you to comment on that or to agree or disagree with me, but I just note it for the record. A. Well, I think that the flow control limitation is different.

Q. Now, I refer you to that portion of Claim 9 which has the marginal note "Flow Control Limitation B." A. Yes, sir.

Q. And here again, as I read it, we have the heats of adsorption and desorption substantially balanced within said bed? A. Yes. And that substantially the sole transfer of heat to and from the gas occurs within said bed, yes, sir.

Q. Doesn't that say about the same thing as accused Claims 16 and 17 so far as your having the heat balance between the beds at an ambient temperature? A. It doesn't say the same things in my view in that, of course,

Charles W. Skarstrom—for Plaintiff—Direct

16 defines the temperature of the system such that the total temperature, the temperature of the operation at the terminals of this system are the same in Claim 16.

Q. Well, like Claim 16, Claim 9 at Flow Control Limitation B says that "the time periods being each of such short duration that the heats of adsorption and desorption are substantially balanced within said bed and that substantially the sole transfer of heat to and from the gas occurs in said

.

[361] CHARLES W. SKARSTROM, called as a witness, being first duly sworn, was examined, and testified as follows:

The Clerk: Will you please state your name and address for the Court.

The Witness: Charles W. Skarstrom, S-k-a-r-s-t-r-o-m, Montvale, New Jersey.

The Clerk: Montvale?

The Witness: Yes, sir. Do you want the street address?

The Clerk: This would be sufficient.

Direct Examination by Mr. Huettner:

Q. Dr. Skarstrom, how old are you? A. As of today, sixty-seven.

Q. And are you employed? A. No, sir.

Q. What is your capacity at the present time? A. Retired.

Q. And how long have you been retired? A. Since January 1st, 1970.

Charles W. Skarstrom—for Plaintiff—Direct

Q. And immediately prior to your retirement for whom were you employed? A. Esso Research & Engineering Company.

Q. And how long were you employed by Esso Research & Engineering Company, or their predecessors? [362] A. Approximately twenty-seven years.

Q. Dr. Skarstrom, would you give me your formal educational background. A. I got my Bachelor's degree at Columbia University in 1929.

Q. In what specialty, Dr. Skarstrom? A. Physics and mathematics. Major, physics.

My Master's degree to '33 at Columbia in physics. Ph.D. at the University of Virginia in 1939.

Q. And what was your Ph.D. degree in? What was your thesis? A. My thesis was to prove the existence of the chlorine isotope 37.

Q. Dr. Skarstrom, since being employed with Esso in what capacity have you worked for them? A. As an employee.

The Court: What did you do?

The Witness: Yes, sir.

The Court: What was your job?

The Witness: My job was to—the formal name of the position, of the project I was on was called Control of Processes.

By Mr. Huettnner:

Q. And what did that encompass? A. It encompassed devising unusual instruments to put [363] in oil refineries in order to give information that they did not have before. Better to control the processes therewith.

Charles W. Skarstrom—for Plaintiff—Direct

Q. What kind of information? I mean what kind of information would these devices provide? A. In general, they provided information as to the composition of the materials that were flowing into and out of the processes.

Q. Were these gas measuring or gas detecting devices? A. Mostly.

Q. Have you been involved with gases with Esso? Is that an important phase of your employment or your research? A. Indeed, all my professional life, sir, I have been studying and devising ways to separate gases and measure the separations accomplished thereby.

Q. Dr. Skarstrom, in 1956—do you have any approximate remembrance of when you made the invention of the patent in suit, which is your patent No. 2,944,627? A. I do.

Q. When was that approximately, Dr. Skarstrom? A. In the latter part of 1956.

Q. By the way, Dr. Skarstrom, do you have any other patents? A. Yes, sir.

Q. About how many? A. About thirty-five.

[364] Q. In 1956, immediately preceding the making of the invention of the patent in suit, what projects were you working on for Esso Research & Engineering? A. I had a number of projects going at the same time. One of them was the development of a water analyzer. Another one was the development of a composition analyzer for bottled gas as it was manufactured.

Q. Did either or both of these projects require any driers? A. They did.

Q. Did one or both? A. Both.

Charles W. Skarstrom—for Plaintiff—Direct

Q. Did you have any driers, therefore, in your place of operation? A. Yes, sir.

Q. Were you in a laboratory at this time, Dr. Skarstrom? A. Yes, sir.

Q. Where was that laboratory located? A. At the Bayway Refinery in Linden, New Jersey.

Q. What driers did you have in your laboratory in 1956? A. I had two.

Q. Would you be good enough to describe the two driers that you had in your laboratory at that time? A. Yes, sir. One of them was very much like the one on display, only it had heaters in it.

[365] Q. You are pointing to Exhibit Plaintiff's 15? A. Yes, sir.

Q. It had heaters in it? A. Yes, sir.

Q. Do you happen to know the manufacturer of that drier? A. Yes, sir.

Q. Who was the manufacturer? A. Trinity Equipment Company.

Q. That was one drier. You had a second drier? A. Yes, sir.

Q. What kind of a drier was that? A. Well, I considered a large heatless drier.

Q. A large what? A. Heat regenerating drier.

Q. What do you mean by heat regenerating drier? A. It had heaters built into it which generated the bed when the heaters were used.

Q. And who was the manufacturer of that drier? A. Also Trinity Equipment Company.

Q. How large was that other drier? A. It was rated at

Charles W. Skarstrom—for Plaintiff—Direct

a hundred cubic feet a minute, contained one cubic foot beds, two of them. That's how large it was.

Q. Physically in comparison to the drier of Plaintiff's Exhibit 15 how large was the other drier? [366] A. Well, these beds are of the order of—

Q. You are pointing now to Exhibit 15? A. —Exhibit 15, of approximately a pound of material in each bed.

The ones I had had approximately 50 pounds in each bed, so the big one was about 50 times bigger than the one T—I can't read it.

Q. 15. A. The one on display.

Q. Specifically, Dr. Skarstrom, what were you using the driers for in your projects that you were working on in 1956? A. The small one was used as part of the water analyzer that I had invented and was currently testing in Bayway, another one, but I had in the laboratory a small heat regenerating drier for having a water analyzer work in the laboratory all the time.

The large drier was part of the gas analysis system for the bottle gas that was going to be used in an oil refinery, but I had it being tested out in the lab before sending it out to a refinery.

Q. Dr. Skarstrom, had you used driers before this, before 1956? A. Yes, sir.

Q. What was the nature of the driers that you used before [367] 1956? What kind of desorption did they have? A. They were all heat regenerating type driers.

Q. Similar to the ones you had in your laboratory? A. Yes, sir.

Q. How many years prior to 1956 had you been exposed

Charles W. Skarstrom—for Plaintiff—Direct

to this kind of drier? A. I'm just guessing, but I imagine about four or five years prior to this time.

Q. Dr. Skarstrom, did anything happen to one of your driers in 1956? A. Yes, sir.

Q. Would you explain to the Court what happened? A. One of the heaters burned out in that small heat regenerating drier.

Q. Dr. Skarstrom, where is the heater located in a heater drier that is similar to Exhibit P-15? A. Along the central axis of the cylinder.

Q. Is it inside the cylinder? A. Inside the cylinder.

Q. And when it burned out what happened to it physically? A. No heat.

Q. Well, what was the cause of the no heat? A. It had burned out.

Q. Did you break— A. I'm not being flippant. I'm answering your questions.

[368] The Court: Was it a resistance coil of some kind?

The Witness: I never investigated.

The Court: It just went out of whack?

The Witness: It no longer functioned.

The Court: All right.

By Mr. Huettner:

Q. Was the arrangement a dual bed heater drier that you were working with? A. Yes, sir.

Q. Were there two beds each having heaters? A. Yes, sir.

Q. Did they both burn out? A. No, sir.

Charles W. Skarstrom—for Plaintiff—Direct

Q. Just one? A. Yes.

Q. All right. What did you do when the heater burned out in one of the beds of your small drier? A. I called the manufacturer and asked him to get me a new heater.

Q. And what was the response to that call? A. Didn't have one in stock.

Q. Did they tell you they would provide you with one? A. Yes, sir.

Q. And did they provide you with one? A. Subsequently; eventually.

[369] Q. Prior to their providing you with one did anything happen? Were you concerned about the inability for the drier to function? A. Yes. I wanted to use it.

Q. When the heater burned out what happened to the drier, your use of the drier? A. It stopped.

Q. And did you do anything to make the drier useful? A. No, sir.

Q. Well, did it just sit there forever? A. It sat there.

Q. And did you ever make any changes to the drier with the burned out heater? A. No, sir. I was waiting for the new heater to come in.

Q. All right. But did it come in? A. Not right away, no.

Q. Did you do anything before it came in? A. To what?

Q. To the drier. A. No, sir.

Q. It just sat there? A. Yes.

Q. Dr. Skarstrom, the next time you operated this drier did you operate it as a heater drier? [370] A. No, sir.

Q. Dr. Skarstrom, after the heater burned out in the drier and it was standing there inoperable did you do anything to the drier? A. Oh, yes. I made an experiment with it.

Charles W. Skarstrom—for Plaintiff—Direct

Q. What did you do? A. Driving to work one morning I decided that I ought to try, on the basis of a hunch, to see whether I would get it to operate without a heater.

Q. What gave you the hunch, Dr. Skarstrom? A. I don't know.

Q. And what was the hunch? A. That I should try it without the heater.

Q. And did you try it without the heater? A. I did.

Q. Did you do anything physically to the drier before you used it without the heater? A. Yes, sir.

Q. What did you do to it? A. I changed the timer.

Q. Did the drier, when it was operated as a heater drier, have a cycle timer? A. It did.

Q. Do you recall what the duration of the cycle timer was when it was operated as a heater drier in your laboratory? [371] A. Yes, sir.

Q. What was it? A. Six hours on stream adsorbing, three hours cooked, three hours rest.

Q. When you say three hours rest, Dr. Skarstrom— A. That's the cool down period, sir.

Q. After the— A. The heater went off after three hours of cooking and the chamber cooled off.

Q. So total would it be a twelve hour cycle time? A. Yes, sir.

Q. Did you replace this timer? A. I had a gear that fitted this timer that would cause the cycle to be thirty minutes on adsorption and thirty minutes for the regeneration period. I installed that particular gear and proceeded to do the experiment to see whether I could get it to work without the heater.

Charles W. Skarstrom—for Plaintiff—Direct

Q. And what did you observe when you operated it with this new timer? A. I was surprised because it did some drying.

Q. After you observed this result what did you next do?

A. I had another gear in stock that allowed me to go to a twenty minute cycle; twenty minutes on adsorption, twenty minutes regenerating. So I installed that gear.

Q. And did you operate the drier with that gear? [372]

A. I did.

Q. What were your observations when you operated the drier with that gear? A. The product got drier, to my pleasant surprise.

Q. Did you expect this result, Dr. Skarstrom? A. No, sir.

Q. Did you do anything after you put in the second gear?

A. Yes, sir.

Q. What was your next movement? A. To increase the purge.

Q. All right. Now, would you explain? A. During regeneration.

Q. Increase the purge during regeneration. What kind of purge did you have from the drier when it was used as a heater drier? A. The manufacturer specified that about 3 per cent of the throughput should be used as purge while using—during the regeneration, heat regeneration cycle.

Q. Three per cent of the throughput. Is that 3 per cent of the product, Doctor? A. No, sir. It is 3 per cent of the feed.

Q. Where is the throughput? A. I consider that to be the feed.

Q. The feed? A. Yes, sir.

Charles W. Skarstrom—for Plaintiff—Direct

[373] Q. Where did one take the throughput for purge use in the heater drier? A. From the product end.

Q. From the product end? A. Yes, sir.

Q. So that it had been dried? A. Yes, sir.

Q. So it wasn't feed, it was product? A. Exactly.

Q. And the specifications required that you remove how much of that product? A. About 3 per cent.

Q. Now, as I understand it, you changed the valve which regulated this 3 per cent? A. Yes, sir.

Q. What did you do with regard to that valve? A. I got a bigger one installed. Took that one, the original one out, and put a bigger valve in.

Q. What did the larger valve do? A. It allowed me to go to a larger purge flow rate.

Q. Do you have any recollection of what purge flow rate you went to at this time? A. Yes, sir. A half a cubic foot a minute.

Q. And how did that compare with your feed? A. I don't understand the question.

[374] Q. How did the volume of the purge compare to the volume of the feed when you put this— A. It was a larger percentage than I had been previously using.

Q. Do you have any recollection of what the feed was at this time? A. Yes, sir. I was trying to have a dry product of a half a cubic foot a minute and plus whatever purge I was using would constitute the amount of the feed. I had increased the feed from approximately .02 cubic feet a minute to approximately $\frac{1}{2}$ a cubic foot a minute of purge and a half a cubic foot a minute of product, so the sum would be about one cubic foot total of feed.

Charles W. Skarstrom—for Plaintiff—Direct

Q. Was the feed under pressure, Dr. Skarstrom? A. Yes, sir.

Q. And was the purge being discharged at atmospheric conditions? A. Yes, sir.

Q. And was the dry product being discharged at the same or substantially the same as the feed pressure? A. Yes, sir.

Q. Dr. Skarstrom, I think we have now gone to the steps of reducing your cycle time to approximately twenty minutes. A. Yes, sir.

Q. And you have changed the purge valve— [375] A. Yes.

Q. —to accommodate a substantially larger product purge.

Did you do any further alterations to your drier? A. I found that this larger purge improved the dryness of the product and I altered the arrangement of the purge valve.

In the original arrangement the purge flowed first in one direction through the purge valve to purge one bed, and then in the other directions through the valve to purge the other bed. And I was annoyed that the same setting on the valve produced different flows in one direction than the other direction.

Q. So you altered some of the piping on the drier to direct the purge in the manner you— A. In the manner so that the purge flow would always go through the valve the same way, no matter which bed was being purged.

Q. Would go through a common purge valve? A. A common purge valve, always in the same direction.

Charles W. Skarstrom—for Plaintiff—Direct

Q. Now, did that help in your purge? A. Yes, that kept the same quantity, flow rate of purge no matter which bed was being purged. Before that they weren't quite the same and that annoyed me.

Q. Dr. Skarstrom, did you make any further changes on [376] the device? A. Yes, sir.

Q. What were they? A. I went to a faster cycle timer.

Q. How did you do that? A. I had to take out the one that was in there and get another one that would go to faster cycles.

Q. And what were those faster cycles? A. The first one I used happened to be $11\frac{1}{2}$ minutes and $11\frac{1}{2}$ minutes; totaling 23.

Q. Did you use it on that, sir? A. I did.

Q. And what were the results of that? A. The product became drier than it had been before.

Q. Then what did you do? A. Then I went to the maximum speed of this new timer, which happened to be 3 minutes and 3 minutes; the fastest gear that I had in the laboratory.

Q. And did you use that timer? A. I did.

Q. What were the results of that timer? A. The product became quite dry and I was very pleased.

Q. Dr. Skarstrom, when you say "quite dry" can you tell us what measurements we are talking about now? A. I was using my own invention water analyzer to measure [377] the moisture content of the product. And in going over my recorded charts I have lost the calibration, so I cannot give you a figure that I had at the time. But I knew that the 3 minute cycle/3 minute cycle was producing the best results I had ever seen.

Charles W. Skarstrom—for Plaintiff—Direct

Q. The best results you had ever seen? A. With this experiment.

Q. What did you do next, Dr. Skarstrom? A. The next problem was to devise an experiment so that I could report it to my management, that I had discovered something. So I shut off the timer and allowed one bed to be flowing all the time, overnight, 24 hours a day. And I made a measurement of the incoming water and the outgoing water and kept the flow going until they were the same.

Then I isolated that bed and did the same thing to the other beds, so that I could load these two beds up to the maximum amount of water they would accept under the line conditions.

Q. What condition, what would you call that condition that the beds were in? A. That is called saturation.

Q. What did you do after loading your beds to saturation? A. Then I turned on a 3 minute/3 minute cycle timer and took data for the next week—the results appearing in [378] Figure 2 in the patent.

Q. And what were the results of the data that you accumulated over this week period? A. The first few hours the 4,000 parts per million, which was the starting condition, had dropped down to several hundred parts per million by operation of a few hours.

The beds got cold, of course, because water was being removed from them.

The next day the moisture level of the product was lower than the one at 200 parts per million, and it continued to become lower and lower as the week progressed.

Charles W. Skarstrom—for Plaintiff—Direct

Q. Do you have any present recollection of how low it finally ended up at the end of the week? A. Yes, sir.

Q. What was the final, the lowest that you can recall? A. My instrument read one part per million. Subsequently I found that one part per million was not water, but it was the fact that it was measuring CO₂ unbeknownst to me. So I would say that the moisture content of the product was below the level that I could measure.

Q. What was the lowest measure you could read at that time? A. The recorded chart that was indicating this one part per million was about 2½ inches on the recorded chart. So I would presume I could measure at least 10 per cent of 2½ inches, [379] which would be one-tenth of one part per million.

Q. One-tenth of one part per million. And you were achieving this dryness after a week's operation? A. Yes, sir. I was very impressed.

Q. Now after this week of operation did you make a report? A. Yes, sir. Oral and written.

Q. And what happened to that report? A. It went into the files.

Q. Did it ever come out of the files? A. No, sir. Subsequently I wrote a patent memorandum, as we were supposed to do.

Q. Then what happened when you wrote the patent memorandum? A. I filed the patent memorandum.

Q. And what happened to the patent memorandum? A. It went through channels, sir.

The Court: We are not going to get this down to one-tenth part per million.

Charles W. Skarstrom—for Plaintiff—Direct

A. That's a large organization. Subsequently, sir, it was examined by a committee to give it a classification: action, no action, throw it out. There were a number of categories.

Q. And did it go to a committee? A. Yes, sir.

[380] Q. Was action taken upon it? A. It was given a classification which I don't remember.

Q. Subsequently did the people in the Patent Department consult you? A. Subsequently, yes.

Q. And was a patent application eventually filed on this particular invention? A. Yes, sir.

Q. And is that the patent that we are litigating here? A. Yes, sir.

Q. Dr. Skarstrom, did you ever get that heater or the heating rod for your drier? A. Yes, sir.

Q. What happened? How did you get that heating rod? A. Mr. Axt brought it to my lab.

Q. That's A-x-t? A. A-x-t, Robert C.

Q. Brought it to your laboratory? A. Yes, sir.

Q. At that time was the drier which had the burned out heater being operated without the— A. Yes, sir.

Q. Dr. Skarstrom, when you were operating the drier with the burned out heater, what did you do with the other heater in the other bed that was not burned out? [381] A. Let it there. Disconnected it.

Q. It was disconnected. So there was no heat going into either side of the drier? A. Yes, sir.

Q. Did you show your operation, your heaterless operation to Mr. Axt? A. I did. I told him I didn't need the stupid heater.

Q. And what was his reaction? A. He was appalled.

Charles W. Skarstrom—for Plaintiff—Direct

Q. And did you have any further dealings with Mr. Axt concerning your drier, your heaterless drier? A. Yes, sir.

Q. Would you tell me what they were? A. Well, he communicated with his management that this system worked without any heaters, and they became interested, and I believe subsequently came to Esso Research & Engineering Company and asked for a license to manufacture it.

Q. Dr. Skarstrom, do you have—or did you have, until your retirement, heaterless driers in your laboratory? A. Yes, sir.

Q. How have they been operating for a substantial period of time? A. Yes, sir. I had one that I used as a master which operated for thirteen years until I retired, ex-vacations.

The Court: I'm not with the company. Don't [382] look at me.

A. And it was the referee for the laboratory, since it dried down to such low levels that there was no water dew point, no CO₂ dew point, no oil dew point at liquid nitrogen temperatures.

Q. You operated this drier for thirteen years? A. Yes, sir.

Q. Did you ever have any failures in the drier beds during this period? A. In the beds, no.

Q. For thirteen years? A. Same material. No problems.

Q. And it continued to operate for this length of time?

Charles W. Skarstrom—for Plaintiff—Direct

A. The valves and the electrical timer had occasion to break, serviced maybe once every two or three years.

Q. Mechanical failure? A. Mechanical failure, yes.

Q. From the timer? A. The timer was one item that failed and the valve, the electric solenoid in one of them burned out.

Q. Did you have any other driers that operated for longer periods of time in your laboratory? A. Yes, sir.

Q. What was the next, what was one other one? A. That was a big, to my way of thinking, a large one [383] containing 4 inch diameter beds, 6 feet high.

Q. How long had that one operated in your laboratory, approximately? A. Oh, eleven or twelve years, I guess.

Q. Again did you encounter any difficulties with the drier beds? A. None with the drier beds.

Q. When you were operating your drier for this week period during saturation, from saturation down, did you have a chart, a graph chart recording? A. My recorded chart basically was my notebook.

Q. Did you have a large rolled chart that recorded? A. Indeed, yes.

Q. And was this the chart that was introduced during your deposition? A. Yes, sir.

Mr. Huettner: Your Honor, I would like to mark as Plaintiff's Exhibit 17, I believe it is—

Mr. McCormick: It is on your list.

Mr. Huettner: Is it? I'm sorry.

Yes. 10, the Skarstrom chart.

Although the whole chart is here, there are certain areas that we have extracted and made Xerox copies

Charles W. Skarstrom—for Plaintiff—Cross

of it, so we will not use the whole thing. It will be only a certain number of pages.

[384] The Court: All right. Full exhibit.

(Plaintiff's Exhibit 10: Skarstrom chart, marked full exhibit.)

The Court: Is anybody going to look at that in this case?

Mr. Huettner: We have Xeroxes of the pertinent areas and we may have one Xerox page from it.

The Court: All right.

Mr. Huettner: I have no further questions, your Honor, from Dr. Skarstrom.

The Court: Cross-examination.

Cross Examination by Mr. McCormick:

Q. Dr. Skarstrom, do you recall that at the time I took your deposition down in New Jersey I asked you to make a sketch of the heater type drier that you had modified in the making of this invention about which you have been testifying? I ask you if this paper of which I show you and which is marked as Defendants' Exhibit E-5 is that sketch?

A. Yes, sir.

Q. Would you also please take a look at this drawing, which I have had our draftsman prepare to try to incorporate everything in your sketch in what I regard as a more legible and readable instrument. A. Yes, sir. What was the question.

Q. I ask that you compare them and tell me if the draftsman's [385] preparation is a faithful representation of what is shown in your sketch? A. No sir, not quite.

Charles W. Skarstrom—for Plaintiff—Cross

Q. Except for two red marks, is that correct? A. No, sir. You've got the flow going the wrong way through this rotometer.

Q. I think you— A. I was going up there because the rotometer's got to flow up.

Q. But the flow goes out of the rotometer on the opposite side of the valve 13, does it not? A. Yes, sir.

Q. Now, except for the rotometer being upside down, then this is a faithful representation, and except for the two red marks? A. Yes, sir.

Q. Any other discrepancies? A. Not that I can see at the moment.

Mr. McCormick: If the Court please, I would like to offer, with the corrections suggested by Dr. Skarstrom, as Exhibit E-5 the draftsman's rendition of that sketch.

The Court: What did you call it?

Mr. McCormick: E-5.

The Court: All right.

[386] (Defendants' Exhibit E-5: Sketch, marked full exhibit.)

By Mr. McCormick:

Q. Do I understand from my observation of this drawing that it shows the heater type drier that you were using in your laboratory prior to the time that the heater burned out? A. Yes, sir.

Q. Now, in that heater type drier where did the purge gas come from? A. From the product ends of the bed.

Charles W. Skarstrom—for Plaintiff—Cross

The Court: From where?

The Witness: From the product ends of the beds.

The product ends of the bed.

The Court: All right.

Q. That would be the same then as shown in Figure 1 of your patent. In the heater type drier the product gas came out here and then there was a reduction in its pressure and this was used to purge? A. Yes, sir.

Q. And in the heater drier that was just the same, is that correct? A. Yes, sir.

Q. As represented in the sketch E-5? A. No. This was my revision of the heat drier as far as the valves were concerned, for my purposes.

[387] Q. Well, now in your Direct testimony I don't recall that you said anything about revising the valves. A. Well, I have it written on the recorded chart.

Q. What did you do to the valves? A. I explained in my previous testimony I put a bigger one in. Then I revised it so the flow was always the same direction through the bigger valve.

Q. But initially, before you put the bigger valve in, you operated with the valves that were on the heater type drier, is that correct? A. Yes, sir.

Q. And initially you operated heaterless and obtained good results with the original valve from the heater type drier? A. No, sir.

Q. Didn't you say that even your first result on that thirty minute cycle surprised you in that you were able to get a dry product? A. Yes, sir. It was encouraging.

Charles W. Skarstrom—for Plaintiff—Cross

The Court: Was there any change in the valve up to that time?

The Witness: No, sir.

The Court: All right. Go ahead.

By Mr. McCormick:

Q. Then your initial heaterless operation with the [388] drier that you had on hand took place only by disconnecting or cutting off the two heaters and by changing the timer so that it would operate on a thirty minute cycle, is that correct? A. No, sir.

Q. What else did you do? A. Opened the purge valve wide, the purge valve that was on it initially.

Q. Which is the purge valve as shown in the drawing here? A. Well, the drawing doesn't show the arrangement of the original heat regenerating drier.

Q. Does this show the arrangement of the original heat regenerating drier? And I'm pointing to the blowup of Figure 1 of your patent. A. No, sir.

Q. What was the arrangement of the original heat regenerating drier then? A. The purge valve was cross connected between the two product outlines of the two beds. Just a straight connection of a valve between the two beds.

Q. Didn't you prepare this exhibit—and I refer to the yellow sheet now—in response to my request to show what the original heater type drier had? A. Yes, sir.

[389] Q. Where is the purge valve there? A. As shown in what you submitted. But that was after I made the revisions.

George R. Feeley—for Plaintiff—Direct

The Court: What is the number?

The Witness: The No. 13, valve No. 13 is basically the purge valve. This is the way I ended up.

The Court: Purge valve?

The Witness: No. 13.

The Court: All right.

The Witness: That's the arrangement I ended up with. Originally that valve had been cross-connected between the two pipes coming out of the tops of the beds.

By Mr. McCormick:

Q. And you must have done something other than just cut off the heaters and add a timer; you shifted the position of the purge valve 13, is that correct? A. Yes, sir.

Q. Anything else? A. That's all.

Q. Down at the bottom of the drawing Defendants' Exhibit E-5, or near the bottom of it, there is shown a four-way valve. Do you see it? A. Yes, sir.

* * * * *

[400] GEORGE R. FEELEY, called as a witness, being first duly sworn, was examined, and testified as follows:

The Clerk: Would you give the Court your name and address.

The Witness: George R. Feeley.

The Clerk: How do you spell that?

The Witness: F-e-e-l-e-y, Boca Raton, Florida.

George R. Feeley—for Plaintiff—Direct

Direct Examination by Mr. Huettner:

Q. Mr. Feeley, how old are you? A. Fifty-seven.

Q. Are you presently employed, Mr. Feeley? A. I am semi-retired and on a part time basis function as a manufacturer's representative in Southern Florida.

Q. What is the general field that you are a manufacturer's representative? A. I handle two basic product lines: chemical pumps and air cleaning devices that might be referred to as electrostatic precipitators.

Q. Mr. Feeley, prior to your retirement who was your employer? A. Pall Corporation.

Q. And that's spelled P-a-l-l, Pall Corporation.

And have you been affiliated with any company that sells driers? [401] A. Yes.

Q. What company was that? A. The Trinity Equipment Corporation.

Q. And is that the Trinity Equipment Corporation that has been referred to in this case? A. Yes, sir.

Q. Mr. Feeley, do you have any formal education? A. Yes.

Q. Have you attended college? A. Yes.

Q. Did you receive a degree? A. I did.

Q. From where? A. I have a Bachelor of Commercial Science degree in foreign commerce from the University of Notre Dame.

Q. What year did you receive that? A. 1937.

Q. Mr. Feeley, briefly after graduation what did you do? A. I functioned as a manufacturer's agent in New York for a brief period, perhaps a year and a half-two years, and then went into the manufacturing business.

George R. Feeley—for Plaintiff—Direct

Q. What did you manufacture when you went into the manufacturing business? A. Our product line consisted primarily of thermowelds, which are the protective covering for a temperature sensing device [402] in a process as well as some sensing devices usually referred to as thermocouple assemblies.

Q. Where were thermoweld and thermocouple assemblies used? A. Generally in the chemical process industries primarily, oil refineries, chemical plants, power plants.

Q. How long were you involved in this particular line of business? A. Twenty years.

Q. Did it grow from the time you first entered it? A. Yes.

Q. Did you become incorporated? A. Yes. We operated first as an individual proprietorship, then a partnership, and from 1947 a corporation.

Q. Now, when you became a corporation in 1947 were you still selling the same products? A. Yes, sir.

Q. What was the name of the corporation? A. Trinity Equipment Corporation.

Q. Trinity Equipment. And did you have on your staff any technical people? A. Yes.

Q. What kind of technical people were these? A. Well, we had several engineers, engineering aides, draftsmen.

[403] Q. Now Mr. Feeley, are you yourself a technical person? A. No, sir.

Q. What is your specialty, Mr. Feeley? A. Selling.

Q. After the incorporation of Trinity Corporation did you expand the business? A. Yes.

Q. And in what manner did you expand it? A. Well, in addition to the expansion of the products that we had

George R. Feeley—for Plaintiff—Direct

made, we acquired another small company called Industrol Corporation.

Q. Would you spell that, please? A. I-n-d-u-s-t-r-o-l.

Q. And what were the products manufactured by Industrol Corporation at the time of acquisition? A. Desiccant air driers.

Q. And what kind of desiccant air driers were these that you first came in contact with, Mr. Feeley? How were they described generically? A. I presume for the purpose of this here we would refer to them as heater type driers.

Q. Heater type driers. How did you refer to them at the time? A. Well, it all depends on who you were talking to. However, they were devices to remove moisture from compressed [404] air.

Q. They had heaters in them? A. The means of reactivating the desiccant was by the introduction of heat, yes sir.

Q. And were the driers that you sold since the acquisition of Industrol in 1949 all of this nature? A. Yes.

Q. They all had heaters? A. Yes, sir.

Q. Was this your first exposure to driers? A. I'm not sure that I understand the question.

Q. Before the acquisition of Industrol Corporation had you been exposed to driers, generally? A. I was aware that there was such a piece of equipment, yes.

Q. But prior to that you had no direct contact? A. Correct.

Q. At the time you acquired Industrol Corporation were there other people, other manufacturers in the drier business? A. Yes, sir.

George R. Feeley—for Plaintiff—Direct

Q. Can you name some of the leading ones? A. Pittsburgh, Lectro Drier—that's L-e-c-t-r-o.

Kemp. I forget the initials, but there are two initials before the name. C. F. Kemp, I believe, or C. M. Kemp.

[405] Pritchard, Kansas City.

Q. Would you spell that, please? A. P-r-i-t-c-h-a-r-d.

Q. What kind of driers did these manufacturers make? And we are speaking now of the time you acquired Industrol Corporation, which was about 1949. A. They made desiccant type driers that were reactivated by introducing heat.

Q. Did they have heaters within the beds? A. Some had heaters within the beds.

Q. What did the others have, that you know of? A. Heaters outside the beds.

Q. At this time did you ever know of any driers that did not have some kind of heaters? A. There were no automatic driers that did not have heaters. However, there is a reference to driers where merely a tank is used that is discarded after it becomes saturated.

Q. Do you know of any reactivated driers— A. No, sir.

Q. —that did not have heaters? A. No.

Q. There are some where they just discarded the desiccant? You were aware of some? A. Yes.

[406] Q. Where did they use that kind of a drier? A. Oh, refrigerants; practically all refrigerators have one, for example.

Q. And after it becomes saturated you throw it away? A. Right.

Q. After the acquisition of Industrol did Trinity Corporation go into the drier business? A. Well, we operated

George R. Feeley—for Plaintiff—Direct

the business as Industrol for a number of years. I believe you would say Trinity was in the business, yes.

Mr. Huettner: I would like to introduce into evidence Exhibits 6-A, 6-C, 6-D and 6-E, which are brochures from the Trinity Corporation.

We have already introduced 6-B.

The Court: Very well.

(Plaintiff's Exhibits 6-A, C, D and E: Brochures of Trinity Corporation, marked full exhibits.)

By Mr. Huettner:

Q. Do you have Exhibits 6-A and 6-B in front of you, Mr. Feeley? A. I do.

Q. What do those exhibits depict? A. They describe a Trinity Type A heat reactivated drier.

[407] Q. Would you refer to the Exhibit 6-B and on the Table 5 there are some cycle times given. Were you familiar with cycle times in the sale of driers? A. Very much so, yes.

Q. What is cycle times? What does that mean? A. Well, there had been substantial confusion in this regard in the industry by the determination of cycle time or the mention of cycle time in specifications. Originally some people interpret it to be the time that a chamber was on stream. Other people interpret it as twice that length of time.

A trade association of drier manufacturers was formed back in the '50's within the framework of N.E.M.A.—

George R. Feeley—for Plaintiff—Direct

that's the National Electrical Manufacturers Association—at which time one of the things that was done was to standardize or formalize certain things, one of which was the definition of cycle as it referred to desiccant driers.

You see the reference there "N.E.M.A. cycle", which means the complete cycle through which the drier passes to return to a point at which it started, or the time that both chambers operated through both functions.

Q. Mr. Feeley, there are some times given in hours on Table 5 of Exhibit 6-B. A. Right.

Q. Are these times common for the driers described [408] therein? A. Yes.

Q. And on the same exhibit there is an illustration of a typical electrically heated desiccant chamber. Is that a schematic of a typically heated drier, a drier with a heater?

A. Yes, sir. As made by Trinity.

Q. Now, the heater driers that were manufactured by Trinity, what did they use for their purge gas? A. The gas itself.

Q. Was this gas that came off the dry chamber? A. Yes.

Q. The drying chamber? A. Right.

Q. How much of the dry gas did the Trinity heater driers use for purge? A. It varied in the order of 2, 3, 5 per cent; something in that order of magnitude.

Q. After your Trinity Corporation acquired the Industrol Corporation did the business of Trinity in combination therewith expand greatly through the following years? A. Yes.

Q. And as of about 1957 how many employees did the

George R. Feeley—for Plaintiff—Direct

Trinity Corporation have? A. About 150, as I best recollect.

[409] Q. Did the Trinity Corporation have any contact with Esso Research & Development? A. Yes, sir.

Q. In what way? A. Well, Standard Oil of New Jersey and their various affiliates were one of our best customers for both of our product lines.

Q. In 1956 and '57, Mr. Feeley, where was Trinity Corporation located? A. In Roselle Park, New Jersey.

Q. Roselle Park, New Jersey. Is that near Esso Research? A. Yes, sir.

Q. How far away? A. Three or four miles.

Q. Did you supply driers to Esso Research? A. Yes.

Q. Do you have any knowledge of them being supplied to the laboratories? A. Yes, sir.

Q. Who was your salesman for the Esso account, or were you in charge of the Esso account? A. Originally I had handled it, and there were two or three other people over the years who were involved in solicitation of business from Esso.

Q. Around the latter part of 1956 or 1957 who was in [410] charge of the account? A. Mr. Robert Axt.

Q. Did you have any personal contact with Dr. Skarstrom? A. Yes, sir.

Q. Did you know of any work that Dr. Skarstrom—did you know of any changes that Dr. Skarstrom made on any of the Trinity heater driers? A. Yes.

Q. What did you know? A. I knew that Dr. Skarstrom, in the course of his experimentation, had found that he was able to produce very interesting results using a drier without heaters.

George R. Feeley—for Plaintiff—Direct

Q. What do you mean by "very interesting", Mr. Feeley?

A. Primarily performance-wise extremely low exit dew points.

Q. And did this achievement surprise you? A. Yes, because it was almost contrary to everything that all the literature had said up to that time as to what you had to do to get moisture out of a desiccant.

Q. Up to that time what had, to your own personal knowledge, all the literature told you? A. That you had to change the environment by introducing heat.

Q. When you say change the environment, change the environment of what? [411] A. The environment of the desiccant.

Q. And up until that time had you heard of anybody changing the environment without the use of heat? A. No, sir.

Q. After you heard of Dr. Skarstrom's heaterless drier what did you do at Trinity Corporation? A. We went to see the Esso Legal Department and inquired about some kind of licensing arrangement or other means of our participating in the invention to manufacture and sell that equipment.

Q. Did you negotiate such a license? A. We did.

Q. And you did manufacture? A. We did.

Q. Can you recall approximately when you began manufacturing? A. I'm somewhat vague. My recollection is something around 1957.

Q. Did you make a number of units when you first started manufacturing? A. Well, we made them one at a time. Almost every one of the first, I believe, 25 that we

George R. Feeley—for Plaintiff—Direct

made were a different size and slightly different configuration.

Q. And did you try and sell these units? A. We certainly did.

[412] Q. And did you sell them with ease? A. No. We had substantial difficulty, as a matter of fact.

Q. Now, Mr. Feeley, as far as the costs were concerned, was the cost of your manufacture of a heater drier or a heaterless drier more? Which was more expensive? A. The heater type drier was more expensive.

Q. And when you sold the heater drier or the heaterless drier with the same capacity what was the sales price? A. It's a hard question to answer without an explanation of capacity because different factors had to be taken into consideration. But for the most part, and I think perhaps in every instance, the heaterless drier would turn out to be less expensive.

Q. And as far as profitability to the Trinity Corporation, which was more profitable? A. The heaterless drier.

Q. And in spite of this you had difficulty selling it, is that correct? A. That's right.

Q. What kind of difficulty did you encounter? A. Well, principally convincing—the sale of this kind of equipment is made primarily to engineers. The problem was to convince an engineer that this thing would work, because according to his background and information on this sort [413] of thing it wouldn't work.

Q. How did you go about convincing him it would work? A. We made some little demonstrator models with plastic tanks.

Q. And were these driers? A. Driers, right.

George R. Feeley—for Plaintiff—Direct

Q. Demonstration models? A. And actually ran them, treating the desiccant with, I believe, a material called cobalt chloride—although I'm not sure about that—which turns pink in the presence of moisture and blue in the absence of moisture.

And we were able to demonstrate with this machine that had no heater in it that it would, in fact, remove the moisture and reactivate automatically without any heater.

Q. And after such demonstrations were you successful in making sales? A. Yes.

Q. And how long did this initial period of sales resistance last? A. Well, it's something that didn't start on a day and end on a day, so it's hard to say how long. But I would say that after about a year or a year and a half the road began to get substantially easier.

Q. Did you also go into large size heaterless driers? A. Yes.

[414] Q. And to what size did you finally expand your line, how large are the largest heaterless driers? A. I'm not sure today, but in my time at the company I believe we were up about in the order of 10,000 standard cubic feet a minute.

Q. 10,000 standard cubic feet per minute of product or feed? A. Feed.

Q. Mr. Feeley, as a salesman when would you try and convince a person to purchase a heaterless drier in preference to a heater drier? A. Well, there were certain times when circumstances were such that the heaterless drier would seem to be the proper piece of equipment, and there were other circumstances when the heater drier would seem to be the proper piece of equipment. The distinction be-

George R. Feeley—for Plaintiff—Direct

tween the two was usually one involving the pressure of what you have been referring to as the feed.

Q. Now, in a heaterless drier I think we established that the initial cost was what compared to a heater drier? A. Well, I can't put a number on it because it would vary with the circumstances on every job.

Q. All right. A. It was lower, but it would vary from one job to another.

[415] Q. All right. Can we compare the maintenance of a heaterless drier to a heater drier? A. Well, we found after a while that we could definitely prove that the maintenance of the heaterless drier was substantially lower and it was fairly easy to see because the things that created most of the maintenance problems were eliminated. That is, the heaters and the heater controls.

Q. With regard to safety features such as explosion-proof, was there a preference of one over the other? A. Well, it was easier and less expensive to make the heaterless driers explosion-proof because there were so many less things that you had to enclose in the explosion-proof housings.

Q. Mr. Feeley, I will show you Plaintiff's Exhibits 6-C and 6-D and ask you if these depict the typical heaterless driers that were sold by Trinity? A. They do.

Q. Mr. Feeley, I will show you Exhibit 6-E and ask you what that brochure is? Is that a Trinity brochure? A. It is.

Q. What does brochure 6-E, which is labeled Type HP Heaterless Desiccant Drier show? A. This shows a heaterless desiccant drier on which all electricity has been elimi-

George R. Feeley—for Plaintiff—Direct

nated by the use of a pneumatic timing device, timing and switching device.

[416] Q. In other words, all the timing and switching is done pneumatically rather than electrically? A. Right.

Q. No solenoids and things of that nature? A. Right.

Q. Mr. Feeley, what is the driest that you've seen any air produced under the heaterless drier? A. Down to fractions of one part per minute.

Q. One part per? A. One part per million and when it got that low I ceased to be interested.

Q. Can you tell me where one would use air that dry, where have they used heaterless driers with such low moisture content? What uses have we had for them? A. Well, there aren't very many when you get down that low.

Q. Have they been used because of that low temperature, low moisture? A. Yes, they have been.

Q. Can you give me some examples of where they are used? A. One that was rather dramatic was in the launching of the Vanguard Missile, one of the very early missile launchings, when substantial difficulty was experienced in two or three launch attempts. They found that the problem was that in their pneumatic systems when they loaded the liquid fuel [417] onto the missile they were freezing up the moisture in the pneumatic lines or condensing moisture out and freezing it and putting the controls out of commission.

One of the rather early heaterless driers was sent down to Cape Canaveral and put in the pneumatic system that charged the missile systems and with the drier in place the successful launch was made.

Q. Was that a Trinity drier that was used? A. Yes, sir.

George R. Feeley—for Plaintiff—Direct

Q. A Trinity heaterless drier? A. Yes, sir.

Q. Are there any other applications where this low moisture content is advantageous? A. Yes. There are a few in electronic manufacturing. I believe the coating of the electron tubes was one instance where an extremely low dew point was desirable and necessary.

I've been away from it for some time now and I have a little trouble recalling specifics.

Q. It's only what you recall. A. Right.

Q. Were you an officer of Trinity Corporation? A. Yes.

Q. What position did you hold? A. President.

Q. How long were you president of the Trinity Corporation? [418] A. From 1947 until 1962.

Q. And in 1962 what position did you change to? A. Well, the business was merged or sold to the Pall Corporation in 1961. One year later I moved to the headquarters of Pall in Glen Cove, New York, as their Vice-President of Marketing.

Q. And how long did you remain with the Pall Corporation? A. For about seven years, a little over seven years.

Q. That would be about until 1969? A. Right.

Q. And with the Pall Corporation what was your position? A. Vice-President of Marketing.

Q. Did that include knowledge of the drier sales of the Trinity Corporation Division? A. I was aware of the sales, but the bulk of my effort and time was spent in completely different product lines.

Q. With regard to the sales of the heaterless drier while you were with the Pall Corporation as Marketing Vice-President from 1962 to 1969, can you tell me how they

George R. Feeley—for Plaintiff—Cross

reacted? Did they go up, down, stay the same or what?
A. The drier sales have—

Q. This is heaterless drier sales. A. I don't believe that I was aware of the breakdown [419] between the different types of units.

Mr. Huettner: All right.

We have no further questions, your Honor, of Mr. Feeley.

The Court: All right.

Cross-examination?

Mr. McCormick: Will your Honor give me a minute to speak to my associates?

(Pause)

Cross Examination by Mr. McCormick:

Q. Now reviewing, Mr. Feeley, if you please, you were the President of the Trinity Equipment Corporation before its merger or acquisition by Pall, is that correct? A. Right.

Q. And you were Vice-President with Pall-Trinity, or with Pall, until your retirement, which I understand took place in 1969? A. Correct.

Q. When did the Trinity Equipment Corporation first receive a license from Esso; do you recall? A. I'm not sure of the date. It was, I believe, sometime during 1957.

Q. Could it possibly have been in March of 1958? A. It could have been, I guess.

Q. I'm not trying to be tricky or anything like that,

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John Prutzman—for Defendants—Direct

[454] taken upon myself to refresh my memory on this technology by consulting the literature, text books, etc., and I, of course, studied the prior art too.

Q. Do you think you understand the subject matter of the patent in suit and of the prior art? A. Yes, I believe so. The basic technology is to be found in your high school and college level physics books and, as a matter of fact, there's a section on adsorption in the Encyclopaedia Britannica, for example. It's not a highly esoteric art in my opinion.

The Court: What you are saying is you think even a federal judge might understand it.

The Witness: I think so, your Honor.

Q. You mentioned in your testimony that you had examined the file history of the patent in suit.

Mr. McCormick: That file history, your Honor pleases, has been introduced in evidence as J-5, Defendant's Exhibit J-5.

The Court: All right.

Q. Did you understand from the reading of that file history that earlier applications had been filed by Dr. Skarstrom? A. Yes. And it is, of course, referred to in the patent in suit. I believe the second paragraph on the first page says "the present application is a continuation

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John Prutzman—for Defendants—Direct

[462] dependent.

Q. I note at the bottom with asterisk the words "marginal notes referred to accompany claim analysis chart" and I'm reading from Exhibit R-5. A. Yes.

Q. Do you have that chart before you? A. Yes, I do. This is a chart that—

Q. Well, is this something that you prepared? A. Yes. This was prepared at my direction.

Q. Well, what do you mean by being prepared at your direction? A. I'm not a very good typist, Mr. McCormick. I told the typist what to type and where to type it.

Mr. McCormick: If your Honor please. I would like to have marked for identification this chart that the witness has been talking about as Defendants' Exhibit U-5.

The Court: Any objection to its admissibility?

Mr. Huettner: Yes, your Honor. This is the first time I have seen this chart and I have no idea what it says and it is a long detailed one from my first glance.

The Court: Mark it for identification.

(Document referred to was marked Exhibit U-5 for Identification.)

The Witness: Your Honor, do you mind if I [463] put this up here.

The Court: No, that's perfectly all right.

Q. If you please, will you explain in a general way what the chart U-5 is and how you had it prepared? A. Yes. What that chart is is taking the information that has been

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generated by the breakdown of the claims in Exhibit R-5. I have transposed these key elements to the left-hand column of this chart. I have used—I have taken a liberty with the language in that I wanted to have the left-hand side be brief and so I did not use the complicated language—that's not a correct way to say it—I didn't use the language necessarily that's in the claim but I paraphrased it and made it brief.

The Court: Well, does the source from which you took it appear on the chart?

The Witness: Yes, it does, because I have labeled—

The Court: Paragraph by paragraph?

The Witness: Yes. For instance, your Honor, on the upper left-hand column there I call "principal process steps claimed" and that's step 1, step 2, step 3 and those are Process Step 1, Process Step 2, and Process Step 3 of Claim 1.

[464] The Court: All right. Why did you do this? Why did you set it up this way?

The Witness: So I could keep it clear in my mind for one thing and I thought it would be of help to your Honor.

The Court: All right.

The Witness: Then I have—

The Court: Is that the only source for what appears on the chart, the patent itself?

The Witness: That is correct, sir. At least so far as what I'm talking about now. I have made some annotations on the right as to the prior art which I feel is

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most pertinent. I have, in the second column, named the claims in which the various steps appear.

The Court: Well, now the prior art to which you refer is that in evidence?

Mr. McCormick: Yes, your Honor.

The Court: It is all in evidence?

Mr. McCormick: Yes. It is within that binder of patents M-5.

The Court: So, the underlying facts upon which this chart is based are all before the Court already.

The Witness: Yes, sir. And I would say,

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[477] add it to 1.

The Witness: Yes.

A. And then you see you get your desorption and f c, the same f c in Figure 5. And you take your o a from Figure 1 and you've got it in Figure 5 and that spread between those 2 is the reaction zone. And it occurs within the ends of the bed.

So, this is to my mind a very clear description of what is said in the claims, particularly the disclaimed claims.

Q. Did I understand you clearly that you regard the description given at Page 2 as indicating that a part of the dried gas is used for purging? A. I think that is the clear meaning of that statement, yes.

Q. Do you have further comment to make at this time on this particular patent? A. Well, I think perhaps it might be well to point to the bottom paragraph of Page 1 of the translation in which the broad statement is made that the usual assist for adsorption and desorption like cooling and

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heating or pressure reduction, etc., can, of course, be utilized. And I take this as meaning that you can or cannot have heating depending on whether you want it and you can or cannot use a pressure differential indicating that these are matters [478] of selection.

Q. Well, that is borne out, is it not, at the beginning of Paragraph a, Page 2 where you referred to where it was indicated that the process could be operated at ambient temperature? A. Yes. That I think is the purpose of A is to explain what happens when you operate at ambient temperatures and where you used a purged gas volume which is 1, 2 or 3 times the raw gas volume.

Q. Do you want—unless you want to comment further at this time on this particular patent we will move on.
A. I have no further comment.

The Court: Well, the purged gas volume gets 1 or 2 or 3 times the raw gas volume by reason of its being released from pressure; is that it?

The Witness: That is true, sir.

The Court: All right.

Q. Now, going down to flow control limitation A2, would you read that, please? A. The recitation is "the duration of flows in opposite directions will develop an oscillating concentration of moisture within the bed during both adsorption and desorption which oscillates within the limits of the bed".

Q. Where was that statement taken from and paraphrased?

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John Prutzman—for Defendants—Direct

[505] from a courtroom or from a text book? A. That's a technical law, Boyle's Law. Just like Dalton's Law. And it states purely and simply that the volume of a gas, assuming the temperature is the same, is inversely proportional to its absolute pressure.

Q. Where would one find a recitation of Boyle's Law and Dalton's Law? A. You can find those in any high school physics book.

The Court: There's none in evidence, is there?

Mr. McCormick: Pardon me. There is no such text book in evidence, no, sir.

Q. Where did you find this limitation A4? A. That's in accused claim 24.

Q. And I note your comment in the column farther over to the right about an inherent requirement.

Would you explain that, please? A. Well, in order to take out as much water as you put into the bed you've got to use equal volumes of gas. That is, that the purge gas volume is just as much as the initial gas going through when pressured at their respective pressures.

The Court: Well, this is a law of Physics, right?

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[508] Q. And will balanced operating conditions result from that? A. Yes, because the volumes will be the same and the components there will be at their partial pressures which, of course, are four to one, therefore you will get the same amount of desorbing as adsorbing.

John Prutzman—for Defendants—Direct

Q. How about the temperature consideration. Must you have the same temperature or substantially the same temperature? A. Well, always when you make these measurements you assume that you are talking about the same temperature.

Q. On Page 7, down fairly close to the bottom, about eight lines from the bottom, is there anything said about temperature conditions there? A. Yes. I don't know—it's Line 8 in the bottom. It says, "the general temperature level of the unloading and off-loading can vary with the ambient temperature lower or higher."

Q. Does that indicate to you that they are operating at ambient temperature in both beds? A. I think that is exactly what it means.

Q. I note also that you have a reference in the far right MacMullen, U. S. Patent 2,340,398.

Mr. McCormick: That's number 14 in the volume, if your Honor please.

[509] Q. Would you please turn to that patent and tell me where there may be something said about the balanced condition you called attention to. A. Well, I have first referred to column 1 of Page 1 beginning at Line 31. "The effective adsorptive capacity of the silica gel—

Q. What is a silica gel, by the way? A. Well, it's a gel composed of silica. It's an adsorbent.

Q. It's an adsorbent. Okay, go ahead. A. "and consequently the recovery of chlorine—

The Court: Do you distinguish between an adsorber and a desiccant?

John Prutzman—for Defendants—Direct

The Witness: Those in the art seem to use them interchangeably. I think adsorber is a little better than desiccant. A desiccant broadly means a dryer.

The Court: All right.

A. I'll read that again. "The effective adsorptive capacity of the silica gel, and consequently the recovery of chlorine, is limited by the temperature rise due to the heat of adsorption as well as by the adsorbed chlorine. To balance the cycle of such operations, the quantity of chlorine removed in the adsorption step must correspond to that recovered in the desorption step and the net

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[516] temperature control then; is that correct? A. No, 9 and 16 do have the limitation of "B" which is that the duration of flow in each direction is sufficiently short so that the heats of adsorption and desorption are substantially balanced and the temperature of the adsorbent bed remains substantially ambient. That's to be found in 9 and 16.

Q. Then do I read you correctly that it is your contention that the process steps 1, 2, 3 flow control limitation A1, 23, 3, 4 and 5 do not in any way require—

Mr. Huettner: I object, your Honor, as a leading question before he goes any farther.

The Court: Overruled.

Mr. McCormick: Would you read it back so far, please.

(Question on Line 8 was read by the reporter.)

John Prutzman—for Defendants—Direct

Q. Heatless operation of the Skarstrom process? A. May I answer by saying that this can be accomplished with or without heating as set forth in the Skarstrom patent.

The Court: Well, then are these inconsistent? One says you use heat and the other says you don't need to use heat.

The Witness: Accused claims 9 and 16, I think you have to read that to mean that you [517] don't apply heat or cooling, the claims—those other claims that I've talked about.

The Court: Don't say anything about it.

The Witness: Don't say anything about it.

The Court: I see.

Q. Did you read flow control limitation B into the record?

A. "Duration of flow in each direction is sufficiently short so that the heats of adsorption and desorption are substantially balanced and the temperature of the adsorbent bed remains substantially ambient."

Q. You apparently find some reference to that in these prior art patents mentioned on the right, including MacMullen which is number 14 in the volume, your Honor.

The Court: Yes, I have it.

Q. Would you point out to me where MacMullen was significant in this regard? A. Well, I think the references are all in the first page. I believe I testified as to part of it earlier. Take column 1, Page 1, starting at 35. "To balance the cycle of such operations, the quantity of chlorine

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removed in the adsorption step must correspond to that recovered in the desorption step and the net temperature increase of the gel during adsorption must [518] correspond to the net temperature decrease of the gel during desorption."

So that I think that says that they balance.

Q. Would you read on down from about Lines 46 to 50, please? A. Yes. "The present invention provides an internal thermal balance which is not impeded by the low conductivity of the silica gel and permits improved recovery of chlorine in such operations."

Then turning to column 2 at Line 22 "Also, the cycle of operation is internally balanced, making the operation truly cyclic, in a manner which eliminates the low thermal conductivity of the silica gel as an impediment to the heat exchangers involved. Heat exchangers within the charges of gel are effected, in accordance with this invention, by the adsorption of chlorine, by the vaporization of chlorine, and by the gas mixture itself passing through the gel." And skipping down a few lines to Line 41. "The operation is with advantage carried out with a series of separate charges of silica gel which are at regular intervals transferred as such from the desorption step to the secondary adsorption step, then to the primary adsorption step and then back to the desorption step, each charge of gel leaving the desorption step at a temperature."

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[520] further ten minutes were sufficient to remove the added load without raising the temperature."

In other words, at the same temperature by means of

John Prutzman—for Defendants—Direct

purge gas volume which is three to four times the effective raw gas volume.

Turning over to Page 5 of the translation going down about the middle of the paragraph to about the middle of the second full paragraph there is the statement that, "The fact that through this invention it is possible to obtain high purity of the process gas is still more surprising in view of the fact that high desorption temperatures are not being used and the adsorbent is only partially unloaded at the same or only slightly higher temperature."

Then going down later in that page to the three lines from the bottom—well, let me take the whole sentence—"In this manner, the purge gas is so thoroughly used that per this invention, even a purge gas volume of three to four times that of raw gas volume is sufficient to unload the adsorbent at ambient temperature as well as at the same temperature."

And it goes on to say, "so that a constant purifying effect of better than 99% is guaranteed permanently without that the purge gas has to be heated above the temperature of raw gas."

[521] Q. Isn't there a further reference to operation at ambient temperature at Page 7? A. Yes. At Page 7 about nine lines from the bottom it says "The general temperature level of the onloading and off-loading can vary with the ambient temperature lower or higher."

Q. Now, if you please, let us refer to what you have labeled as an apparatus limitation. Would you please read that for the record? A. Yes. I think that's a complete quote. "Operation as defined by claim 13 wherein said beds are self-contained with respect to the transfer of heat."

John Prutzman—for Defendants—Direct

Q. What does that mean to you? A. Well, I was slightly puzzled by the language there. I examined the patent very closely and I don't find the expression "self-contained" used in there.

The Court: What?

The Witness: I don't find the words "self-contained" used in the specification anywhere. And my understanding of "self-contained" is merely that it's contained within itself. In other words, take a rocket to the moon. It has a self-contained life support system. That's my understanding of it. But, after hearing the testimony I think I know what [522] they are trying to say there. That is you don't have heating or cooling.

Q. On the right you say "operation without heaters and coolers is discussed in the Kahle German Patent 871,886."

Would you refer us to that portion. And that's again number 19. A. Well, I've referred to that several times. On Page 2 of the translation at the top of that subparagraph A it definitely states that the same and approximate ambient temperatures may be utilized. On the previous page, Page 1 at the bottom it says "The usual assists for adsorption and desorption, like cooling during adsorption and heating or pressure reduction, eventually also less than atmospheric pressure, during desorption etc., can of course be utilized. . . ."

So the implication is that you don't have to utilize it and in this one example it is not utilized.

Q. Is there a reference to operation without heaters and coolers in the Chemi Ingenieur Technik article?

John Prutzman—for Defendants—Cross

Mr. McCormick: Which is number 22 in the volume, your Honor.

A. Well, I suppose the last paragraph on Page 5 of the translation, Line 3 of that paragraph, "It was found that at an ambient temperature

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[537] *Cross Examination by Mr. Huettner:*

Q. Mr. Prutzman, what literature did you read to learn about the technical field involved in the patent in suit?

A. I don't have the exact titles. They were physics books that we had in our office library. I went to the local public library and spent an afternoon or two there reading whatever was available there. And I mentioned the Encyclopaedia Britannica, and I've also studied this prior art that has been cited.

Q. You have no remembrance of any of the books that you read? A. Well, I've identified them. Not by name, but I certainly remember the books, yes.

Q. What were the books? A. They were, as I say, primarily textbooks, physics books, etc.

Q. Do you remember any of them now? A. Yes. One is sitting right on my desk. I mean on my desk in my office.

Q. How many books did you read? A. Oh, perhaps a half a dozen.

Q. And how long did it take you to read these books? A. Well, that's a hard thing to say because I went back over them many times.

John Prutzman—for Defendants—Cross

Q. Twenty hours? [538] A. No, I wouldn't say that. Probably five to ten hours.

Q. Five to ten hours to read the books. That's the books. Now, did you read anything else besides books? A. Not other than the patents, no.

Q. And the patents you are referring to are the prior art patents that you have discussed today? A. Yes. Plus those that were cited in the file history and some that I did not discuss. Those that were cited in the answer.

Q. How much time did you spend on reading about adsorption? A. Oh, it probably only took an hour or so. That's a fairly simple subject, I thought. I mean I didn't find it very complicated.

Q. Had you ever encountered adsorption before in your patent career? A. I can't honestly answer that.

Q. Do you have any present recollection? A. No, I don't.

Q. Have you ever encountered desorption in your patent career? A. No, not as such. You mean the subject matter of something I was working on?

Q. So that in about half an hour you learned all that [539] you felt necessary to know about in this case about adsorption and desorption, is that correct? A. Yes.

Q. Do you know how much heat is generated during adsorption with silica gel? A. Quantitatively?

Q. Yes. A. No.

Q. Alumina? A. All I know is that heat is generated.

Q. Do you know how much heat is generated with alumina? A. No, I do not.

Q. Mr. Prutzman, in your practice of patent law you undoubtedly have had the opportunity many times to prepare process claims? A. Yes, I have.

John Prutzman—for Defendants—Cross

Q. In preparing process claims does one define the various—does one set forth the various steps required in the process? A. Yes, one does.

Q. And if one does not set forth the step that is not included in the process, is that correct? A. That is correct.

Q. So that if one does not set forth a step of heating that is not included in a process, is that correct, Mr. Prutz-

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[541] A. Yes.

Q. In order to properly draft claims for a process you set forth in your claim each step of the process that you desire to claim? A. Well, I don't put it that I desired a claim necessarily. Every step you put into a claim is a limitation. If I say in a claim a heating step, that means that claim will cover only processes which have a heating step.

Q. That is correct. A. And if I leave out the heating step it covers a process whether or not heating is present.

Q. Right. Now, if you include a heating step then, of course, that would be a step in the claim? A. That's right.

Q. It's an affirmative step? A. Correct.

Q. And that would be considered a part of the process claimed? A. That is right.

Q. Is the Skarstrom patent a combination of process steps? A. Well, it is more than one step, yes.

Q. So that we have a number of steps in Skarstrom? A. Yes.

Q. In preparing a specification is it essential that

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John Prutzman—for Defendants—Cross

[546] not.

Q. Mr. Prutzman, do you agree with the statement of Dr. Meissner on Exhibit P-16, which was one of the last exhibits before you? A. I don't know whether I retained it. That's the summary of the invention?

Q. Yes. A. I don't think I have it any more.

The Court: Here it is.

Is there a question pending?

Mr. Huettner: Yes, your Honor.

Would you kindly read back the question, Mr. Reporter?

(Question read back.)

A. What do you mean "agree"?

Q. Do you find it an accurate statement, Mr. Prutzman?

A. I haven't looked at it from that standpoint.

Well, this is certainly an accurate statement of what Dr. Meissner described as the Skarstrom process, yes.

Q. And do you agree that this is an accurate statement of the Skarstrom process? A. Yes, I think it will read on it. Yes.

Q. Do you speak German, Mr. Prutzman? A. No, I do not.

Q. And I assume you don't read German? [547] A. Practically not at all.

Q. Before undertaking your assignment with this case, Mr. Prutzman, had you ever seen any heater or heaterless driers? A. Not that I recall. I might have seen pictures of them, something like that.

John Prutzman—for Defendants—Cross

Q. And prior to this experience in court had you ever seen the operation of a heaterless drier? A. No, I have not.

Q. Have you had the opportunity to make any measurements concerning heaterless driers that have been the subject matter of this litigation? A. Make measurements?

Q. Yes. A. No, sir.

Q. Have you made any calculations concerning the process that's carried on with regard to heaterless driers, the subject matter of this litigation? A. No, I haven't had any occasion to do that.

Q. Have you made any calculations concerning the example that is put forth in the patent in suit, commencing on Column 8, Line 12 and carrying through to Column 9, Line 4? A. Beginning at Column 8 where?

Q. Column 8, Line 12 through Column 9, Line 4, there is a description which we did not read of the operation of the [548] Skarstrom invention in which there are a number of figures given as to size, volumes and times. A. Yes.

Q. Did you make any calculations regarding any of the data given in this part of the patent? A. No. I accepted those at face value.

Q. Mr. Prutzman, did you recall Dr. Meissner stating that he made calculations concerning the movement of the reaction zone in the Skarstrom invention? A. Yes, I do.

Q. Is your understanding of this testimony to the effect that the reaction zone in the Skarstrom invention moves less than 1 per cent of the length of the bed height? A. Well, let me say it this way. He testified that this is what happens when you operate an apparatus which he says has been made in accordance with the Skarstrom patent.

John Prutzman—for Defendants—Cross

Now, if that's the invention, I mean I think of the invention as what is described in his patent. There's nothing in the patent about that. But he did say in direct answer to your question that that's what happened in the commercial apparatus that was used.

Q. Mr. Prutzman, I would prefer if you would try and limit your answers to a direct answer to the question, if you can. A. Well, I was objecting to your use of the broad word [549] "invention."

Q. I believe that Dr. Meissner also testified that he made a similar calculation for the example that I have just referred to, which commences in the patent in suit, Column 8, Line 12 and over to Column 9, Line 4. A. I don't recall that part of his testimony, but I certainly don't contradict that.

Q. Do you agree with the conclusion or the statement that the bed in the Skarstrom device that you saw operating here as Exhibit 15, do you agree with Dr. Meissner's statement that the bed moves, as operated, a three minute cycle on, a three minute cycle off, that the bed reaction zone moves less than 1 per cent? A. My recollection on that is that he based that on the amount of air and the size of the bed and the moisture change. I have no quarrel with that mathematics.

Q. Mr. Prutzman, there is nothing in the record concerning Claim 9 with regard to disclaimer, is there? A. Not that I recall.

Q. Mr. Prutzman, would you kindly direct your attention to Claim 14? A. All right.

Q. That claim, Mr. Prutzman, relates to partial pressure? A. Yes.

John Prutzman—for Defendants—Cross

Q. What is your definition, Mr. Prutzman, of partial

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[564] which is the German '223 patent. A. All right.

Q. Now, in your consideration of the Kahle patents, Mr. Prutzman, what kind of a general operation was Mr. Kahle describing in his overall scheme of patents and articles? What did it relate to? What do all his patents relate to?

A. Well, to air separations, I mean, or gas separations.

Q. Yes. But is he not concerned with a liquid air plant? A. Sometimes, yes.

Q. Isn't that what it really is? Isn't that what his article is based on? A. Well, no, not his article. That's the gas fractionation.

Q. It's a gas fractionation used in conjunction with a liquid air plant? A. Yes, that's true.

Q. It's in conjunction with a liquid air plant? A. Well, it's in conjunction with some other operation or plant, yes.

Q. Correct. And are not the '223 patent and the '886 patent and the '541 patent all referred to in that article?

A. Well, they are footnoted at the end, yes.

Q. Yes. So he had all of those patents before him when he was writing the article? [565] A. Yes. And, of course, he was the inventor of those patents.

Q. Yes. And it basically refers to an air separation plant? A. Correct.

Q. And what is the most common product in an air separation plant? A. You mean—

Q. What is one of the gases, the most common gas? A. Nitrogen, I guess.

Q. That's the most common, is it not? A. Also it's the one in largest volume.

John Prutzman—for Defendants—Cross

Q. And is it needed? A. What do you mean by "needed"?

Q. Is it a useful gas? A. Not particularly.

Q. Would you call it an unneeded gas? A. Well, if you don't need it I guess it is unneeded, yes.

Q. Okay. Now, would you refer to Page 2 of the '223 patent, the one you brought to my attention, and turn to—

A. What number is that?

Q. Well, that's the one you said has the 1 to 1 ratio.

The Court: That's 21.

A. 21?

[566] Q. Of product gas to feed gas.

What is the product in the '223 patent, Mr. Prutzman?

A. The product in that patent? It is, I believe, separating CO₂ from—yes, separating CO₂ from air.

Q. Right, that's the product.

Now return to the bottom of Page 2 and I'm more interested, really, in the very short three lines that appear on top of Page 3. What is the purge gas? A. Well, it is referred to as unneeded purge gas.

Q. What is the unneeded purge gas in this entire operation of Kahle? A. Well, in this patent it probably is—it could be the nitrogen from another process, yes.

Q. So that's not a product gas, is it, Mr. Prutzman?

A. By that do you mean a product gas of that—

Q. Of the drying. A. That's right.

Q. So that reference does not disclose a 1 to 1 ratio of the purge gas, an operation in which product gas is used as purge gas in a 1 to 1 ratio? A. Yes, I see what you mean. That is correct.

John Prutzman—for Defendants—Cross

Q. Is there any other reference that discloses this? A. There is one of these references that speaks of a 1 to 1 relationship. I have been unable to put my finger on it.

[567] Q. I don't want to stop your— A. No, that's all right.

Q. Mr. Prutzman, am I correct in assuming that in Claim 14, the one we have been discussing which has the partial pressures, this claim means more than just water in at the feed equals water out at the purge? A. Well, I think that's what it comes out to because by having these equal volumes that's what occurs.

Q. Now, wait a minute. You say it means water in equals water out? A. Yes. Well, water out equals water in, yes.

In other words, you balance the operation.

Q. And how does Skarstrom tell you to balance the operation, Mr. Prutzman, in accordance with Claim 14? A. Well, I think I had a note on that and where it is.

Q. Mr. Prutzman, does Skarstrom not say that the partial pressure of the feed, the partial pressure of the water vapor at the feed must equal substantially the partial pressure of the measurement of the water vapor at the purge? A. Yes.

Mr. McCormick: Objection, your Honor.

There are now two questions pending. I think the witness should be given an opportunity to answer them one at a time.

The Court: Well, he did answer it, I think.

[568] The answer may stand.

John Prutzman—for Defendants—Cross

A. Well, I did want to get my reference to Claim 14, which is Column 7, Lines 44 to 48.

Here it says: "As a result of the backwashing step for desorption of the key component or components from the adsorption zones, to a degree, the components of the secondary effluent product will correspond to those of the initial feed of the gaseous mixture."

Q. Mr. Prutzman, I thought we just went through Claim 14 to explain what partial pressure was, did we not? A. Yes.

Q. Is there anything in what you have read to me that has anything to do with partial pressure? A. Yes. But we also agreed that the partial pressure is a measurement of the percentage or the amount of moisture of vapor present.

Q. Per what? A. Per unit volume.

Q. Correct. A. Yes.

Q. So does not Claim 14 say that the partial pressure is a measurement of the amount of water vapor at the inlet and that this substantially equals the measurement of the amount of water vapor at the outlet at their same unit volumes? A. Yes.

[569] Q. A cubic foot going in has a certain partial pressure, a cubic foot of gas coming out has a same partial pressure? A. Well, what you are saying is that each unit coming out of the purge has the same moisture content as each unit of the gas going in.

Q. But if the amount of purge was excessive— A. Yes.

Q. —if it was four times as much we would not have the same partial pressures, would we? We have resolved that once. A. Yes.

John Prutzman—for Defendants—Cross

Q. Therefore, that would not be Claim 14, would it, if we had four times as much purge? A. That's right.

Q. But the amount of water in would equal the amount of water out under such circumstances, would it not? A. I see what you mean, yes.

Q. So the amount of water in and the amount of water out is not what Claim 14 defines; it is something more distinguished than that, is it not, Mr. Prutzman? A. Well, what it is, I don't comprehend.

Q. It is more than water in equals water out, because that would include a kind of operation in which you would have four times as much purge gas? [570] A. Perhaps it does.

Q. But the partial pressures couldn't be equal, could they, Mr. Prutzman, if we had four times as much purge? A. Well, that is true. But what you are teaching in the patent is that you use basically as much purge gas at its pressure as the gas going in, the feed gas at its pressure.

The Court: Well, I'm not sure I follow this. Am I supposed to follow it, too?

Mr. Huettnner: I hope so, your Honor, somewhat.

The Court: Well, it says: "... wherein the time of each cycle is for a time period so that the partial pressure of the water vapor in the gas at the discharge end of said second bed does not deviate substantially from the partial pressure of the water vapor in the gas at the inlet"—which to me states a result and nothing else.

That when you get through there the partial pressure is the same and I don't see how it refers to a

Colloquy

one to one volume, except at that end and at that very beginning.

Mr. Huettner: Your Honor, the gas at the inlet end has a certain amount of water in it.

The Court: Right. And you can define that in terms of partial pressure.

[571] Mr. Huettner: Yes, your Honor.

The Court: All right. Or measured in terms of partial pressure.

Mr. Huettner: During adsorption that gas gets trapped in the adsorbent.

We have a dry gas coming out. Some of it goes off on product, some of it is led down to desorb the other bed.

The Court: I understand that.

Mr. Huettner: And what this claim says is that per unit volume of gas the partial pressure of the feed gas, the amount of water in the feed gas per unit volume is equal to the amount of water that one has in his purge gas.

The Court: No. I'm sorry. I disagree. Because it doesn't say in the purge gas. It says: "in the gas at the discharge end". Now, that's after it is desorbed.

Mr. Huettner: It is drying out this bed—

The Court: Well, it is purged until it fulfills its function as purge, and then when it is at the discharge end, at the outlet, then it is under the same pressure as the gas that went in on the cycle before.

Mr. Huettner: No, your Honor. At this end [572] the pressure, first of all the partial pressure has nothing to do with pressure as such.

Colloquy

The Court: All right.

Mr. Huettner: It has to do with the amount of water vapor.

The Court: It is a measurement of the amount of water.

Mr. Huettner: It's the measurement of the amount of water vapor that is in the gas at this end.

The Court: Only after it has completed its desorption process.

Mr. Huettner: It is continually desorbing during the three minute desorption.

The Court: But when it comes out that's when you measure it.

Mr. Huettner: It goes out to atmosphere.

The Court: When you measure it there, yes.

Mr. Huettner: When you measure it here the amount of water in the gas here per, let's say, 1 cubic foot is equal to—

The Court: A cubic foot that you are going to put in.

Mr. Huettner: The amount of water that is in the gas that initially goes into this system.

[573] The Court: Right.

Mr. Huettner: But the claim says that the two—since the partial pressures are equal and partial pressure is a measurement of moisture per specified area and since the partial pressures are equal, the areas of gas have to be equal.

In other words, the area of gas, one cubic foot going in—

The Court: The volume.

Colloquy

Mr. Huettner: The volume has to be the same as the volume coming out.

Now, that's what the claim says. But if we had just a 1 to 1, without a pressure reduction, we would have no product because everything that would go in would come out.

You see, the claim says the volumes are equal.

The Court: It says the volumes are equal in quality or in volume and in quality. But I understood that when you sent this in through the inlet, then you compressed it so that you had three times—

Mr. Huettner: It is compressed right here.

The Court: All right. So you had three times as much going through and you take one-third of that back or one-fourth of it, whatever it is.

Mr. Huettner: Yes. Your Honor, but if we [574] opened this valve completely, no product, and took all of the gas through here to desorb, when it comes into this area, if let's say this were 60 pounds absolute and this is down to zero, it would expand four times; four atmospheres.

The Court: All right. You are sending it through under pressure.

Mr. Huettner: It goes through under pressure here, all the gas. We are not having any product. We are having it passed through here.

Now it is being expanded down to atmosphere. So we have the volume that's four times as great.

Since that takes out all the water that was put in, the partial pressure of the water of that expanded gas is only one-quarter of what the partial pressure is of

Colloquy

the gas that went in. Partial pressure is a measurement of the water vapor in a unit volume. So that what this claim says is don't use all your product; use just enough so that you are able to take out the moisture, but no more.

The Court: Yes.

Mr. Huettner: That's the limitation in the claim, your Honor. And the rest is product.

Now, the prior art says you can use four times as much purge. We know we can desorb this bed. [575] There are lots of ways of doing it. You could heat it, you can use lots of purge gas.

But this claim says don't do that. Use just enough to get out the moisture. And how do you do it? They tell you how to do it. Make sure the partial pressure of the purge is equal to the partial pressure of the feed.

The Court: The product of the purge.

Mr. Huettner: There is no product. Well, whatever comes through.

The Court: I mean the purge. It isn't the pressure of the purge. It is the pressure of purge plus desorbent.

Mr. Huettner: What you have is the dry gas that has taken out all the moisture.

The Court: Right. You don't take the pressure there.

Mr. Huettner: No pressure involved.

The Court: That's right. You take the pressure at the end after it has desorbed some of the water.

Mr. Huettner: No pressure involved. It has just adsorbed some water vapor. The gas has picked up

Colloquy

the water vapor. It has picked up just as much water during desorption as was adsorbed during adsorption.

[576] The Court: I understand.

Mr. Huettner: And the volume of purge gas, according to Claim 9, the volume, it's a limit on the amount of gas to use here on your purge.

The Court: It is about 1 to 3 or 1 to 4?

Mr. Huettner: No. It's about 1 to 1, your Honor. The prior art is 1 to 3 and 1 to 4.

The amount of gas that comes out of here, out as purge, is equal in volume to the amount of gas that comes in here.

The gas that comes in here, if it be 2 cubic feet per minutes, goes in here, but at pressure. But still 2 cubic feet. Pressurizing it doesn't increase the amount of flow. So you have 2 cubic feet of gas passing this point.

The Court: Under pressure.

Mr. Huettner: Under pressure. You will have 2 cubic feet of gas being exhausted, going into the atmosphere.

The Court: Not under pressure.

Mr. Huettner: Not under pressure.

The Court: Right.

Mr. Huettner: What you will have up here is about one and a half cubic feet being used as product, [577] under pressure.

The Court: All right.

Mr. Huettner: Now, what Claim 14 tells you is how to regulate this system so that one can achieve maximum product and still desorb. In other words, make ready the bed that was previously used so you can

Colloquy

flip back and forth. It tells you how much purge gas one needs to make this cycle operable and in accordance with the teachings of the patent.

It tells you how much gas is needed to desorb the bed that was previously used for adsorbing it. And how does it teach you? It teaches you by partial pressures of purge compared to partial pressures of feed with regard to moisture content.

The Court: All right.

Now these partial pressures, you say the feed is a partial pressure determined or measured under pressure?

Mr. Huettner: Yes.

The Court: And the purge outlet is a measurement of partial pressures not under pressure?

Mr. Huettner: Yes.

Your Honor, I think our difficulty comes in the term "partial pressure." That has nothing to

* * * * *

[592] The Court: Now, this load that you are talking about--

Mr. Huettner: I meant zone, your Honor. I thought I corrected myself. It is a movement of the reaction zone.

The Court: I don't know whether he is talking about a reaction zone here on Page 3 or whether he is talking about the quantity of adsorbed material in the bed.

He is talking about: "Effective volume should be understood to mean the actual volume occupied by the gas, which is inversely proportional to the pressure of

John Prutzman—for Defendants—Cross

the gas of the same weight. Under these conditions, the residual load amounted to 8 per cent and the added load each time to approximately 14 per cent of the equilibrium value."

I don't know what that is.

By Mr. Huettner:

Q. Mr. Prutzman, do you want to comment on that? A. Well, those percentages refer to the per cent of equilibrium value and the equilibrium value is the value when the gas and the adsorbent are in balance.

So if you go to 8 per cent of that value, apparently there's 92 per cent left. And if you go to 14 in that case, it would be 86 per cent left.

[593] Q. In other words, maybe we can try it this way, Mr. Prutzman. When they desorb was there still about 8 per cent of the bed that was loaded? A. Yes. If you think of it as being concentrated at one end, yes.

Q. Then when it says they loaded up 14 per cent on adsorption, in other words they went up 14 per cent? A. Or go to 14 per cent, one or the other.

Q. And in these beds that we have, Mr. Prutzman, is there a clean line of demarcation or is there a zone? A. It's my understanding that there is a zone.

Q. So that when it moves up 14 per cent it would be a zone moving up 14 per cent? A. Yes.

Q. If you picked, let's say, a certain point in the zone, that would move 14 per cent? A. Right.

Q. Upward? A. Correct.

Q. And would this approach breakthrough, Mr. Prutzman? Would this movement as described in the '223 Kahle

John Prutzman—for Defendants—Cross

patent approach breakthrough? A. I would believe that it would be well below breakthrough.

Q. Would you see where he says to stop his movement? [594] And I refer to the same paragraph, but a little farther down. A. Yes. At the latest when 90 per cent.

Q. He comes pretty close to breakthrough, does he not? A. Well, he says at the latest.

Q. Does Mr. Kahle describe cycle times for this particular drier on Page 4? A. Yes. It starts at the bottom of the preceding page: "a switching cycle of between 5 and 30 minutes. . . ."

Q. When does he use the 30 minute cycle? A. He goes on to say: "Near atmospheric pressure, one would operate in the area of the lower limit of the cycle time and at higher pressure in the area of the upper limit. . . ."

Q. Does Skarstrom operate at atmospheric pressure? A. You are talking about at desorption stage?

Q. The Skarstrom adsorption. A. Adsorption, in the specific example, is above atmospheric.

Q. Would you consider that at increased pressure as considered to atmospheric? A. Yes.

Q. Therefore, would it be appropriate to correlate the 30 minute cycle of Kahle to Skarstrom? A. Well, you would go toward that time, yes. That's what he says.

Q. Rather than the short end?

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[598] so that when you adsorb you get the best product.

The Court: It isn't direct, anyway. It doesn't have any direct effect on purifying the gas. It sets up your adsorber a little better, maybe.

John Prutzman—for Defendants—Cross

I didn't mean to talk like an expert with sort of regular authority. Forgive me. I was just trying to understand.

By Mr. Huettner:

Q. Mr. Prutzman, would you be kind enough to turn to the Kahle article, which is Tab 22 and identified as Plaintiff's Exhibit 5-F.

Do you know what the purge gas is in this article? A. Well, the article has to do with quite a number of processes. Insofar as the article is concerned, I guess that the references are to processes in which you use a purge gas other than what you get from the adsorption stage.

Q. In other words, it is not a product purge that is referred to in this article? A. I believe that's correct.

Q. It is some extraneous gas that is involved in a liquification process? A. Well, from wherever it comes from.

Q. You referred to the principle of partial loading and partial unloading on Page 5. [599] A. Yes.

Q. I direct your attention to the bottom of that section of the article, the last paragraph. Does that paragraph teach you the volume down at the very last two lines, the volume of the purge gas to be used? A. It says: "... purging with a volume of about three times of purge gas...."

Mr. McCormick: May I hear the question that is pending, please?

Mr. Huettner: There is none pending.

Mr. McCormick: I'm sorry.

John Prutzman—for Defendants—Cross

Q. Would you refer to your Hasche patent '773, Tab 9.

On Column 1 does that patent teach you to heat to desorb?
I refer to Line 29 and following. A. You referred me to what, sir?

Q. Line 29 and following. A. Of what?

Q. Column 1. A. What's the question?

Q. Does that patent teach you that one heats to desorb?
A. Well, my recollection of this patent is that I believe it has both, but let me just check my notes on that.

Yes, according to my notes you have heating for one of the separation stages, but not for both.

Q. You have heating for desorption in this patent?

* * * * *

[608] Q. Well, he doesn't say add a heater to make my thing work, does he? A. No.

Q. It is not a process step in Skarstrom? A. But he doesn't say positively leave it out, either.

Q. But he doesn't say for my operation to work I need heat? A. No, that's correct. It is not limited to the use of a heater.

Q. Now, you discussed, to some extent, the Dailey patent No. 2,535,902. That is Tab No. 15.

Now, in the Dailey patent would you kindly turn to Column 3, Line 26. And it might be helpful to make reference to the drawings while we are going through this little paragraph here.

Would you read that paragraph and tell me whether or not the desiccant becomes saturated? A. That's what the first line says: "When the desiccant in tower 3A becomes saturated, . . ."

John Prutzman—for Defendants—Cross

Q. Now, to try to expedite this, we have a heat exchanger in there, do we not? It's down around Line 35. A. "... and the heat exchangers (12-14)...." Is that what you are referring to?

Q. Right. And heat exchanger 12. What does that do? I'm on Line 38. [609] A. "The heat exchanger 12 is controlled to heat the gas to some maximum temperature, usually 600 degrees F.,..."

Q. And what reaction does that have on the desiccant? A. It heats it.

Q. To what degree, what temperature? A. Well, the next line says:

"As the temperature of the desiccant approaches 200° F., water vapor is given off in very large quantities,..."

Q. Why is water vapor given off? What is happening to the moisture in this particular process? A. Well, if it is of 200 degrees F it is getting close to the boiling point.

Q. And the water vapor given off, that's being boiled off, is it not? A. Yes.

Q. At that temperature? So you are boiling off the water; you are not adsorbing it, is that correct? A. Yes, I would say that's correct.

Q. So that what leaves as product, what is the product that leaves this operation? It is a mixture of what?

I refer you to Line 44. A. 44 of that same page?

Q. Yes, sir. A. What column?

Q. Column 3. [610] A. "a mixture of steam and gas leaves the tower 3A at the bottom thereof through header 26."

John Prutzman—for Defendants—Cross

Q. Now, referring to your notes or to the diagram, or both, can you tell me if there is co-current flow in this process? In other words, is the adsorption and desorption flow from the top of the towers down to the bottom? And I'm looking at the drawing. A. No. The flow is not in a reverse direction.

Q. Both adsorption and desorption are in the same direction? A. That's correct.

Q. And you were talking about the thermocouples that were inserted. Where are those thermocouples inserted? A. You mean by reference to the drawing?

Q. Yes. A. Well, if you look in the drawing, the drying tower 3B on the right has the thermocouples 36B and 37B and in the drying tower 3A, 36A and 37A.

Q. Where are they located with regard to the adsorption? Because this is flowing in which direction, Mr. Prutzman? A. Flowing downwardly, I believe.

Q. From top to bottom? A. Yes. The inlet is at the top.

Q. So that the thermocouples are located at the— A. Lower end of the towers.

[611] Q. —the product end of the tower? A. Yes.

Q. So the maximum heat is where in this particular— where is the movement of the zone in this particular vessel?

A. It's between the thermocouples.

Q. At the product end, is it not? A. Yes. Well, it's up a certain distance from the product end, yes.

Q. Does the Dailey patent teach the long cycle or going to saturation? A. Well, what they do is determine when the line goes by the upper of the two thermostats or thermocouples, and so as they find out that the zone is somewhere between those two that's used to reverse the cycle.

John Prutzman—for Defendants—Cross

Q. But the tower 3A goes to saturation, does it not?

A. 3A goes to saturation?

Q. Well, I just read—or you just read, I'm sorry, from Column 3 at Line 26. It says: "When the desiccant in tower 3A becomes saturated. . . ."

So it does go to saturation, does it not? A. Well, that's contrary to what is said over here, that when the zone reaches or goes past the 8 thermocouple that's when you turn on the heater.

Q. This is what I'm trying to establish, Mr. Prutzman. When you read these references did you just extract little bits [612] and pieces to suit whatever you felt was helpful for your case, or did you go over the entire disclosure?

A. Well, I went over the entire disclosure and took out the parts that I thought were pertinent.

Q. Little sentences here and sentences there, rather than saying the tower in this patent goes to saturation; is that correct? A. Well, I just read the parts that were pertinent I thought, yes.

Q. Does a desorbent tower going to saturation have much to do with the patent in suit? A. Well, I'm not so sure it goes to saturation because, as I say, it is terminated when the zone is between those thermocouples.

Mr. Huettner: Your Honor, I have not much more, but I have some more from Mr. Prutzman which we probably could, if I can organize myself a little better, finish up tomorrow morning.

The Court: All right. I think we have all put in a full day today.

John Prutzman—for Defendants—Cross

Adjourn court until tomorrow morning.

(Whereupon, the court was adjourned.)

* * * * *

[656] A. Well, I have a translation written under it which says "purge gas."

Q. And do you have a translation for "Heizung"? A. Yes; "heater."

Q. What is that? A. That's the heater.

Q. That's a heater? A. Yes.

Q. So the purge gas comes in from the right and becomes what, Mr. Prutzman? A. It becomes heated.

Q. It's heated? A. Yes.

Q. And then it goes through the desorption, is that correct? It performs its desorption? A. I'm having trouble with the German language. It goes, according to the top legend there, it goes through adsorbent.

Q. Yes. But what is it doing there? A. Oh, I would assume if it's purge gas it's desorption, yes.

Q. It is desorbing? A. Yes.

Q. And then what happens to it when it comes to the "Kuhlung"? [657] A. It's cooled.

Q. Pardon me, sir? A. It's cooling.

Q. And that's a coolant? A. Yes.

Q. So we have a heater and a cooler in the purge gas flow, is that correct? A. Yes. They're on opposite sides of the adsorbent bed.

Q. Yes. A. Yes.

Q. And if you go in the opposite direction, the "rohgas"—
A. Yes.

John Prutzman—for Defendants—Cross

Q. —that is the same as the feed gas, is it not? A. According to this translation, yes.

Q. And then it goes through coolers? A. Correct.

Q. And then it goes through the adsorbent? A. Correct.

Q. And then it goes through heaters? A. Correct.

Q. Now, do we have heaters and coolers in the Skarstrom invention? A. You don't disclose that, but you certainly can use [658] them.

To further explain that answer, it's very clear in the Kahle article that this idea of partial adsorption and desorption is beneficial in any kind of an operation, whether it's with or without heaters.

Q. Mr. Prutzman, were you in the Courtroom when Dr. Meissner testified that he obtained his Ph.D. in Chemical Engineering in Germany? A. Yes.

Q. And that his Ph.D. was obtained in the German language? A. That is correct.

Q. And that he could read and understand technical German? A. I remember that.

Q. Do you recall his testimony concerning the translation of the word "zer legungs produkt"—and I'll spell that: z-e-r-l-e-g-u-n-g-s-p-r-o-d-u-k-t? Zer legungs produkt? A. I don't recognize the word, but I'm sure I heard whatever he said about it.

Q. Did you hear him testify to the effect that zer legungs produkt as used in the '886 patent, which is the one you just testified to—that's tab 19, your Honor, also Plaintiff's Exhibit 5-B—that the word zer legungs produkt [659] as used in the German itself—and I am now going to refer to the German patent, the original, not the translation; the

John Prutzman—for Defendants—Cross

German Patent '886, which is under tab 19, column 2, page 2, line 35 and line 38. A. I'm sorry. I was looking at the—

The Court: Page 2, column 2.

Q. Of the German patent. Lines 35 and 38. A. Page 2, column 2, line 35?

Q. I'm sorry. On page 2, column 1. I am sorry. Column 35. And again on line 38.

Do you see that?

The Court: Yes.

Q. Do you recall Dr. Meissner's testimony that this word in German as used in this patent is translated as the fractionation product from a liquid air plant? A. Yes, I recall that.

Q. You agree with that? A. I have no basis for agreeing or disagreeing. I don't understand the German language.

The Court: Fractionation product from—

Mr. Huettner: A fractionation product from an air liquification plant.

Q. And do you recall further that Dr. Meissner testified that the purge gas that is used for desorption in this '886 patent was zer legungs produkt, which is not the [660] product being adsorbed? A. Well, I heard what Dr. Meissner said; but, of course, I'm basing my observations on this translation, which apparently everybody agreed on as a true translation.

John Prutzman—for Defendants—Cross

So it says in this desorption that you use a part of the fractionation product in question, and you use a part of it, and that which is not needed for purging can then be obtained pure. So if—

Q. Now, is it not the fractionation product of the liquid air plant as testified by Dr. Meissner? A. That's what Dr. Meissner says. I am just going on what's said in this translation.

And when you say that what you don't need—if you only use parts of it and you don't need for purging you can obtain it pure, to me that reads right on using a part of the primary effluent as a purge gas.

Q. Well, what gas is obtained from an air liquification process? A. Well, are you referring to the nitrogen?

Q. And what other gas? A. Well, the main components of air are nitrogen and oxygen.

Q. And are those not the products of an air liquification process? A. Yes; okay.

* * * * *

[695] Q. And those method or process applications have probably included a large number of process steps? A. Well, yes, some instances. They, of course, vary.

Q. They vary, yes.

Now, if you filed an application which had a claim, process claim, which had a number of process steps and you found out that individually in different patents, piecemeal, that these process steps were found in Reference A, Reference B, Reference C, Reference D, could you conclude that the process claim is invalid? A. Certainly you could conclude that, yes.

John Prutzman—for Defendants—Cross

Q. If no one reference showed all the process steps would you say the claim was invalid? A. I wouldn't say it in the abstract.

Q. You would not say that. A. The patent statute says in order for something to be patentable it has to be unobvious. And if you've got five steps known in the prior art and it's obvious to combine them, you've got an unpatentable invention. If it's unobvious to combine them, then you've got a patentable invention.

Q. The fact that they show up all over the prior art is not, per se, a— A. No, I think this is true. If each one is independent then you have to take the next step, which is to [696] combine them. Is it or isn't it obvious, yes, that's true.

Q. And is it not an accepted principle of patent law that all steps of a process claim must be read in combination and the issue is whether the combination of steps is obvious? A. I think that's basically what I said, wasn't it? That in combining all the steps it's either obvious or unobvious.

Q. It is the combination of steps, is it not, Mr. Prutzman, in a combination process patent which has a number of steps. That is what you look at? A. Well, if you're talking about a combination claim that's what it's got, it's got a series of steps and it's either patentable or it isn't. And if the novelty is that nobody else before put those steps together, yes, you've got an argument. It either is or it isn't obvious.

Q. But even if all the steps are shown it depends on whether or not the combination of steps is new? A. Yes. This is true.

Robert I. Pearlman—for Defendants—Direct

In other words, I think what you are—may I paraphrase it? What I think you are trying to say is that even though a process claim claims only steps which individually are old, it may, under certain circumstances, be unobvious and a patentable invention, a valid claim.

The Court: So this is a combination patent

* * * * *

[721] of the record now.

The Court: It's in the record?

Mr. McCormick: It's in the record as a part of Mr. Pearlman's affidavit.

The Court: All right.

Do you want it to be inserted, received as evidence now in this case at this time?

Mr. McCormick: Yes sir.

The Court: And it will so be received.

Mr. McCormick: All right.

EXHIBIT 11

"September 14, 1961

Heatless Dryer

FILE MEMORANDUM

"Mr. Whelan, Dr. Nagel and the writer visited the Kahn & Co. plant at Wethersfield, Conn. on Saturday, Sept. 9, 1961 for the purpose of reviewing the patent and licensing situation in the heatless dryer field with Kahn & Co. During the first part of the meeting Kahn & Co. was represented by Robert S. Sheldon, Vice President and Ervin B. Steinberg, Patent Attorney. Irving I. Kahn, President,

Robert I. Pearlman—for Defendants—Direct

joined us later when possible bases for settlement were being discussed. Kahn & Co. has an attractive modern plant on the outskirts of Wethersfield, near Hartford.

"Mr. Sheldon started the discussion by explaining [722] that the Kahn heatless dryer had been a natural outgrowth of Kahn's manufacture of heated dryers and other test equipment (mainly for military ground support) and simply represented a routine development based on sound engineering principles. He claimed that Kahn's heatless dryer was developed before the Kahn people heard anything of Skarstrom's or Trinity's work in the same field. Later on Mr. Kahn explained that his company has a very substantial engineering staff devoted to research and development. (25 engineers out of a total force of about 85.)

"Mr. Steinberg then told us that he has made a rather cursory search of the prior art in the Patent Office which has led him to believe that our Skarstrom patent lacked invention.

"He gave us a list of the references which he considers most pertinent. These include the British (Linde) 677,150; the art cited against U.S. 2,955,673 (Kennedy et al); as well as some other patents such as U.S. 1,682,588; British 633,137; and German patents 882,541 and 972,223. We immediately replied that 'we, as well as Kenyon and Kenyon, have been aware of most of the art on Mr. Steinberg's list, including the British Linde patent which in our view represented the best prior art not made of record against Skarstrom. For that reason we stated that off-

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hand we felt that the art referred to by Mr. Steinberg has not materially [723] changed anything, including Kenyon & Kenyon's opinion that many of the important process claims of the Skarstrom patent U.S. 2,944,627 were valid and applicable to the operation of the Kahn dryer. We have in effect admitted that Skarstrom's apparatus claims don't apply to the Kahn dryer.

"During the discussion Steinberg made the point that Kahn dryers usually operated with long cycles of 6 minutes or more, which were substantially longer than anything disclosed in Skarstrom's specification and therefore could not be validly covered by Skarstrom's claims. We replied that we saw no reason why a court or anyone else should read any limitation on cycle length into the claims on the urging of an infringer merely because the infringer operated at numerical values higher than the exemplary numbers disclosed in the patent specification. We have assured the Kahn people that we had no intention of enforcing our patent if they can convince us of its invalidity, e.g. if they can cite us the existence of a commercially used heatless dryer prior to Skarstrom's invention date. The Kahn people have tentatively admitted that they did not know of any such instance but they might want to try checking into it further.

"In response to Mr. Steinberg's request we stated that in our view the essence of the Skarstrom invention [724] involved a combination of the following three features.

1. Reversal of the drying cycle prior to breakthrough;
2. Use of dry product gas for purge; and

Robert I. Pearlman—for Defendants—Direct

3. Utilization of heat of adsorption for driving off moisture during desorption without use of extraneous heat.

"The Kahn representatives replied that reversal of the drying cycle before breakthrough was conventional in any kind of adsorptive [sic] drying. (This is not entirely true since many references speak of regenerating the adsorbent after it has been "saturated".) The use of product gas for purge has been shown in the prior art by Kahle and others, and employment of the heatless principle has been taught by the British Linde patent. We then retorted that while Mr. Steinberg's analysis of the individual references may be correct we nevertheless know of no prior art suggesting the combination claimed by Skarstrom or the unobvious result achieved thereby, and for that reason we had full faith in the Kenyon and Kenyon opinion concerning validity. However, we have agreed that we would carefully review those references on Mr. Steinberg's list which we had not seen previously and that we would, of course, reconsider our position if those references showed anything more pertinent than the other prior art of which we had been aware. We have indicated that we did not consider this likely. Mr. Steinberg has requested that we supply Kahn and Co. with our reasons, as to the grounds on which Skarstrom's [725] most pertinent claims (e.g. claims 9, 16 and 17) should be considered patentable over the art referred to by Mr. Steinberg.

"Next Mr. Steinberg suggested that Kahn & Co. was of course interested in an amicable settlement and that they would be willing to make one even though they con-

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sidered the Skarstrom patent of very doubtful validity. Specifically he said that they would be willing to settle on the basis of obtaining a paid-up license for Kahn & Co. under our Skarstrom patent in return for a paid-up license to "Esso" under Kahn's Kennedy et al patent. We explained that such a license to "Esso" would be worthless to us since we were not in the dryer manufacturing business. Steinberg replied that he didn't have authority to go beyond the proposition he had just made but that this point seemed to present an opportune moment for having Mr. Kahn join us in our discussion. Mr. Kahn did join us at this point.

"When we explained to him that a license under the Kennedy et al patent to Esso would be of no value to us he replied that he would of course include licensing rights to third parties along with a license to Esso. When pressed further by Mr. Whelan as to whether such licensing rights under the Kennedy patent would be exclusive, Mr. Kahn replied he would be willing to make such a grant exclusive subject only to retaining a license under the Kennedy et al patent for his own operations. Next Mr. [726] Whelan expressed serious doubts that even the last proposition could be of any interest to us since it would hardly be made compatible with the 'most favored licensee' clause in our standard heatless dryer licenses. For this reason, Mr. Whelan suggested that while he did not have authority to make any specific proposals he would be prepared to ask our Management's approval for a settlement with Kahn on the basis of Kahn & Co. taking a standard heatless dryer license from us under Skarstrom and Esso getting an exclusive license and licensing right from Kahn

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under the Kennedy et al patent, with the net effect that Kahn would pay us the regular 10% royalty on 2-bed dryers, no royalty at all on 1-bed dryers, and we would pay over to Kahn up to perhaps as much as 50% of royalties hereafter received from our other licensees on their 1-vessel dryers covered by the Kennedy et al patent.

“Mr. Kahn did not seem particularly interested in our counterproposal for two reasons. First, he felt our Skarstrom patent was of such doubtful validity that anything other than a paid-up license on more or less nominal terms would not be acceptable to him as a matter of principle. He expressed the thought that a large company such as Esso should not use a weak patent such as Skarstrom to impose burdensome royalties on ‘small business’. To this we replied that we had an opinion from outside counsel [727] assuring us that we had an enforceable patent, that this patent has received extensive recognition of the industry and that we therefore were proceeding with our licensing program not only in reliance on the best legal advice available to us but also in fair discharge of our contractual obligations to our existing licensees. Incidentally, Kahn also expressed displeasure at our notifying his customers such as General Electric of our Skarstrom patent and its possible applicability to their operations. We told him that this was the only way we could properly bring our patent rights to the attention of those concerned, especially since Kahn & Co. itself had shown little interest in pursuing the matter directly with us when we first contacted them. Kahn also was somewhat irritated by the fact that some of Trinity’s salesmen had been cautioning prospective customers about our patent long before it had

Robert I. Pearlman—for Defendants—Direct

issued. We believe we have satisfied Kahn that any such actions were undertaken entirely without our knowledge or consent.

"Kahn's second objection to our counterproposal was that even though it conceivably could be more advantageous to him in the long run than his own original proposal if the one-bed dryer proved to be extensively used, he felt that it would leave his company's future royalty obligations in an undesirable state of uncertainty.

[728] "The meeting was conducted throughout on a friendly and factual basis by representatives of both parties. Our impression of Kahn & Co. and especially of the apparent competence and alertness of its technical staff and management has been considerably better than what some of our present licensees have led us to expect. Nevertheless, the respective positions of the parties at the end of our meeting have remained very far apart. The prospects of finding a common meeting ground are not very bright. Consequently, we should proceed quickly with a further review of the art cited by Kahn, obtain Management approval for a definite offer to be submitted to Kahn and institute legal proceedings against Kahn promptly if Kahn does not accept our offer soon after we submit it to him.

PETER H. SMOLKA

PHS:res

cc: Messrs. W. C. Asbury, E. J. Brenner, M. R. Mandelbaum, F. L. Miller, R. H. Nagel, P. J. Whelan

"P.S. At lunch we discussed with the Kahn representatives miscellaneous general topics. Kahn explained that his company got into the military test equipment business

Robert I. Pearlman—for Defendants—Direct

in the early post-war years and added the conventional heated dryers to their line of products around 1952-53. Their line of products now also includes a dew point analyzer. We informed them that we had some patents in this field also, and they have expressed a desire to see them. We plan to [729] send them copies of our pertinent patents shortly.

PHS"-

Mr. McCormick: I should like to call particular attention to portions of Exhibit 11, however, if I may.
The Court: Very well.

By Mr. McCormick:

Q. Do you observe at the start of the fourth paragraph in Exhibit 11 at page 1 where it is said:

"He gave us a list of the references which he considers most pertinent. These include the British (Linde) 677,150; the art cited against U.S. 2,955,673 (Kennedy et al); as well as some other patents such as U.S. 1,682,588; British 633,137; and German patents 882,541 and 972,223."

These are patents many of which have been under consideration here in this trial, are they not? A. Several of them, yes.

Q. At that point, when it was said, "He gave us a list of the references," to whom was Mr. Smolka referring?

A. It looks to be Mr. Steinberg.

Q. And in your understanding Mr. Steinberg was Mr. Kahn's patent attorney at that time?

* * * * *

Irving I. Kahn—for Defendants—Direct

[783] Honor. I don't object.

The Court: All right.

(Defendant's Exhibit Z-5: Brochures, marked full exhibit.)

By Mr. McCormick:

Q. Now, at this time—and I take you back to 1955—did you have a line of heater type dryers that you offered for sale? A. No. At that time we really did not, as yet. At that time we were producing solely specialized equipment, custom-built equipment. But we were, at that time, considering to develop a dryer line.

Q. Well, how about the dryers that you mentioned that were incorporated in these various pieces of apparatus, did you build them? A. We built them; designed them and built them ourselves. But we considered them specialized in the sense that we did not have a dryer product line at that time.

Q. They were constructed for use as a part of a larger apparatus? A. Correct.

Q. When did you get into the manufacture of dryers for sale independently of other apparatus? A. I would say this was sometime around 1956, maybe the end of '55. Actually, we engaged at the beginning of [784] 1955 a man solely for the purpose of developing dryers. His name was Starrett, S-t-a-r-r-e-t-t Kennedy, who is also the co-inventor of the Kahn single tower heaterless dryer.

Q. About how many engineering people did you have in 1955 or '56 at the time of your entry into the dryer business? A. I would say our engineering department had about a dozen people at that time, engineers and designers.

Irving I. Kahn—for Defendants—Direct

Q. There has been in evidence here the Defendant's Exhibit TTT which shows a Kahn advertisement of November 1957 of a heaterless dryer. Do you recall whether, at that time, you did have heaterless dryers under manufacture for sale? A. We indeed did.

Q. How did you get into the heaterless dryer activity? A. As I mentioned, we engaged an individual at the beginning of '55 solely for dryer development because, first of all, we were not too happy or entirely happy with the heater type dryers we produced for special purposes. Particularly in the high pressure field with the equipment being used at airports, we found there were certain disadvantages to the heater type high pressure dryer and we felt there should be a better way of drying this air.

And in the course of this work with the high pressure dryers we developed the heaterless dryer, which eliminated the heaters and used the pressure swing principle for drying.

[785] Mr. McCormick: Now, just at this point, your Honor, I want to insert, make it very clear that the defendants do not claim that they were prior inventors to Skarstrom of anything that is shown in the Skarstrom patent.

The Court: All right.

Mr. McCormick: That is one of the matters that has been understood between counsel from the beginning of this case.

By Mr. McCormick:

Q. Mr. Kahn, you've been going so rapidly I have to catch up in my notes here.

Irving I. Kahn—for Defendants—Direct

Now, at the time of this development work which you were undertaking in heaterless drying did you know of any other people in the dryer field who were offering heaterless apparatus for sale? A. At the time we developed our heaterless dryer we did not know of anyone in the field.

Q. Were you successful in developing at Kahn & Co. a heaterless dryer? A. We were.

Q. What did you do about that development? A. We announced it to our sales representatives and we advertised it in the trade papers.

Q. Did you file a patent application on it? [786] A. Yes. We did file a patent application through our patent agent Steinberg. I believe he did file the papers sometime in 1958.

Q. What happened to that application? A. The application was processed and resulted in a patent issuing to us. However, only for part of what we had claimed.

Q. What part remained in the— A. The patent allowed our claim for a single tower heaterless for continuous generation of dry air. But it did not allow our claim for two tower or two-vessel construction continuous operating heaterless dryer, which according to the Patent Office was already in prior art.

Q. And did they cite that prior art to you? A. They did cite prior art.

Q. When did you first receive any indication that your manufacture and sale of heaterless dryers was getting you into difficulty from any source? A. The first indication that there was a claim that we were poaching on somebody else's rights was in October of 1958, when our sales people in the field ran into a situation where they were told that a com-

Irving I. Kahn—for Defendants—Direct

pany by the name of Trinity was claiming that we were violating a patent.

Mr. McCormick: I ask that that which has been identified as Defendant's Exhibit K be

* * * * *

[826] exhibit, subject to objection. Mr. Huettner did not have an opportunity to see these earlier this morning.

Mr. Huettner: We have no objection.

The Court: Strike the identification.

(Defendant's Exhibit A-6: advertisements, marked full exhibit.)

By Mr. McCormick:

Q. Was Kahn & Co. a member of any dryer trade associations or anything of that nature? A. There is none at this time. However, we were members of what had been referred to in this Courtroom before, N.E.M.A., which is the National Electrical Manufacturers Association.

And N.E.M.A. during the late 1950's and during the first half of the 1960's had an Adsorption Drying Section which consisted of members who were in the adsorption drying business.

Q. Did this association have meetings from time to time? A. Yes, there were regular meetings of this association ranging from probably around half a dozen times per year, at which time we attended up to early 1962; Mr. Robert Sheldon attended for our company. After that I attended these meetings because Mr. Sheldon left our employ.

Irving I. Kahn—for Defendants—Direct

[827] Q. Well, how long were you a part of this association after 1962? A. For at least two years that I am aware of and have records of.

Q. Do you know whether any of the Esso licensees were also members? A. Yes, indeed, they were. And I recall it rather vividly because among others Mr. Hoke, who had been mentioned before in this Courtroom, was a member and in his rather remarkable uninhibited manner never let a meeting go by at which point he didn't raise the issue of Kahn producing heaterless dryers unlicensed, as he called it.

There were other members of this group that had licenses and prospective licensees who became licensees afterwards.

Q. How about Pritchard and Company? A. Yes, Pritchard and Company was a member of this group. So was Trinity Equipment Company. So was Gas Drying; Mr. Hoke. So was Dielectric Products Engineering Company. All these were, at the time I attended, already licensees.

Q. Did you have any discussions with anyone other than Mr. Hoke about your heaterless dryer activity? A. Naturally, all of these people who were licensees at one point or another, at one meeting or another. Many a [828] time I mean the more discreet ones on the side asked me, I mean, what's the story. And my answer was a very simple one: that we had had meetings with Esso, we believed the Esso Skarstrom patent to be invalid, and that's where I left it.

Q. But they were aware that you were manufacturing heaterless dryers? A. They were aware at these meetings and they were aware out in the field where we were competing with them on a daily basis; and they were taking

Irving I. Kahn—for Defendants—Cross

jobs away from us and we were taking jobs—orders, I should say, away from them.

As a matter of fact, they were very much aware of it because the Pritchard firm already in 1961 and '62, and I recall again in 1964, complained to their licensor and I know they complained also to DuPont. And that's where we had quite some exchange of correspondence with DuPont justifying our position in the heaterless dryer field and giving DuPont a hold harmless letter.

Q. Now, I believe in your testimony yesterday you mentioned that you had received a telephone call in November 1964 from Mr. Pearlman and suggesting a further meeting between the Esso and Kahn representatives, is that correct? A. Yes. This is correct. I did get a call from Mr. Pearlman on November 30th, 1964 asking whether we would get together again, could get together again on a meeting.

Q. And did you have such a meeting?

* * * * *

[866] Q. Five thousand. In the middle of those negotiations, is that correct? A. There were no negotiations going on. The negotiations had ended. We were sitting waiting from February 11th on. Not hearing anything further, there were no negotiations.

Q. You heard nothing in February. Then the middle of '65 you proceeded with the start of this addition? A. Yes, sir.

Q. And then you made another addition in 1966 which you said could have been made in 1967 had you not been required to alter your first addition? A. Correct, sir.

Q. And suit was filed in September 1967? A. Correct.

Irving I. Kahn—for Defendants—Cross

The Court: Well, wait a minute.

That last five thousand feet went in when?

Mr. Huettner: It went in in 1966, your Honor.

The Court: Put in motion in the summer of '65?

Mr. Huettner: No sir. That was the first 5,000 addition.

The Court: All right.

Q. Mr. Kahn, am I correct that some of your employees, namely, Mr. Kennedy and Mr. Sheldon, filed a patent application for a heaterless dryer? [867] A. Yes, you are correct, sir.

Q. Mr. Kahn, what was their reaction when they first found out about heaterless dryer operation? Do you recall? When they discovered heaterless dryers what was their reaction? A. I do remember one instance where Mr. Sheldon came into my office and excitedly told me about a single tower heaterless operation where he had accomplished with one tower a continuous drying system.

Q. Was he elated? A. Oh, yes, very much so.

Q. Were you? A. Yes. I didn't grasp the entire significance, but it was an achievement and I was delighted.

Q. Had any of your engineers ever seen anything like it before? A. Not that I am aware of.

Q. Had you? A. I certainly had not.

Q. Did you file a patent application, or your company? A. Our company did file a patent application.

Q. In the name of the inventors? A. In the name of the inventors.

Q. And did the Patent Office reject the claims to a dual bed system as illustrated in Figure 1 of the patent in [868]

Irving I. Kahn—for Defendants—Cross

suit? A. They did reject the claims to a two-tower system, and did allow those for the single tower.

Q. Now, Mr. Kahn, were you aware at the time that the Patent Office rejected your claims to a device shown similar to the one shown in Figure 1, that you could have amended or appealed from that action of the Examiner in the Patent Office? A. I was not aware of the details of the patent prosecution at all. As a matter of fact, I don't think I recognized the rejection of the claims on the two tower until sometime later when it came up in connection with, I think, the claim by Trinity that we were infringing on something they were producing.

The Court: Is the record of that patent or any part of the application before the Court?

Mr. Huettner: No, your Honor.

The Court: Do we have the date when this was done?

Mr. Huettner: Mr. Kahn?

The Witness: The application was filed in 1958.

The Court: And the patent was issued when? Do you know?

The Witness: The Kennedy patent was issued

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[870] Q. Mr. Kahn, would you be good enough to refer to the exhibits attached to your affidavit?

Your Honor, that's the exhibits attached to Plaintiff's Exhibit 9. At the end there are some exhibits. The next page, your Honor, is the page that I'm going to discuss.

Irving I. Kahn—for Defendants—Cross

Q. (Continuing) Do you recognize an interoffice correspondence dated November 11th, 1957? A. Yes, I do.

Q. What is this, Mr. Kahn? A. This is a letter written by me to all our dryer representatives telling them about the heaterless dryer we had developed. I'm telling them about the advertising we are doing and the inquiries they may expect and what we would like them to do.

Q. Would you read the third paragraph from the end aloud? A. From the end?

Q. Yes. A. "The theoretical concepts involved are quite complex and need not be gone into by you with a prospect who, after all, is interested in results only."

Q. Do you agree with that statement today? A. I do. But I would like to add to this. When I say "theoretical concepts," I meant for a salesman to try to [871] explain these to a plant mechanic, they would be complicated. For anybody familiar with the art, they would not be.

Q. You would have to be familiar with the art? A. Yes.

Q. Not high school stuff? A. Oh, I would say a science graduate from high school is readily capable of understanding it. He learns about Boyle's law, he learns about Dalton's law, and that's all you have in there.

Q. Do you think you understand all about the operation of the Skarstrom invention, Mr. Kahn? A. The word "all" is very all-inclusive.

Q. Yes sir. A. However, I do believe that I understand the invention or the alleged invention.

Q. And why it operates exactly in the manner in which it does? A. I think I do.

Q. And would you read the next paragraph, please, Mr. Kahn? A. "The advantages are startling: no heaters, no

Irving I. Kahn—for Defendants—Redirect

explosion hazards, extremely simple mechanism, reduced cost."

Q. Do you agree with those? A. I definitely do.

Q. Do you agree with any more? [872] A. I don't know what you mean by "any more."

Q. Are there any more advantages of the heaterless dryer over the dryers heretofore known in 1957? A. I think that sums it pretty much up.

The Court: There is something more. Continuous operation, you mean?

Mr. Huettner: Yes, sir.

The Court: Well, you have to leave something for the salesman to use.

Mr. Huettner: Your Honor, I believe I'm finished. Thank you, Mr. Kahn.

Mr. McCormick: I just have a question or two.

Redirect Examination by Mr. McCormick:

Q. It seemed to me somewhere in your cross-examination you said that your dryer sales were 8 percent of the total Kahn business. Now, by that did you mean heaterless and heater type? A. No. I believe this was a statement which I made in response to a question of Mr. Huettner where he said in a specific year—and I think it was '66—your heaterless dryers, according to these figures, were 8 percent of your total sales volume. And I pointed out that they were only the heaterless and the pressurized dehydrators were not included.

• • • • •

Colloquy

[878] briefing.

The Court: Without replies?

Mr. McCormick: Yes sir.

Mr. Huettner: No, your Honor. I think a reply brief is necessary.

The Court: Well, let's see. Plaintiff's by June 1. We can say Defendant's by June 1.

Defendant's by June 1 and optional reply briefs by June 22nd.

Well, I am grateful to you gentlemen for having tried to educate me in Boyle's law and Dalton's law.

Mr. Huettner: Your Honor, we had in the closet over here Exhibit 15 tucked away, which was that piece of equipment that we had operating here one day.

The Court: I don't see any need to retain that in the possession of the Court or keep it under the responsibility of the Clerk.

Mr. Huettner: We are happy to remove it, unless you want it for any purpose.

The Court: No.

Was it marked as an exhibit?

Mr. Huettner: Yes, it was. But you do have a photograph of that. We submitted a photograph, [879] a Polaroid shot.

The Court: Yes.

Mr. Huettner: If you do want to refresh your recollection.

The Court: I would have enjoyed a cutaway so I could actually see the operation inside. But I suppose nobody knows what goes on inside.

Colloquy

Mr. Huettner: Then we will remove it and retain that exhibit in our custody, subject to inspection any-time.

The Court: Right.

All right. Does that do it?

Mr. Huettner: Your Honor, the charts.

The Court: I think the Clerk will keep those.

Mr. Huettner: We have no objection to that being cut so that you can store it.

The Court: Divide it in two.

All right, gentlemen.

We will adjourn Court for today now.

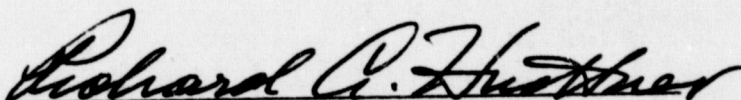
(Whereupon, Court was adjourned.)

UNITED STATES COURT OF APPEALS
FOR THE SECOND CIRCUIT

----- x
ESSO RESEARCH & ENGINEERING COMPANY,
:
Plaintiff-Appellant, :
:
v. : No. 74-1765
:
KAHN AND COMPANY, INC. AND
CHANDLER-EVANS, INC., :
:
Defendants-Appellees. :
----- x

CERTIFICATE OF SERVICE

It is hereby certified that copies of the JOINT APPENDIX and PLAINTIFF'S AND DEFENDANTS' EXHIBITS were served upon Roger B. McCormick, Esq., McCormick, Paulding & Huber, 101 Pearl Street, Hartford, Connecticut 06103 by depositing three copies of the JOINT APPENDIX and one copy of PLAINTIFF'S AND DEFENDANTS' EXHIBITS in the United States mail, postage pre-paid, this 2nd day of December, 1974. Page proofs were mailed to Mr. McCormick Friday, November 29, 1974 and final printed volumes were mailed today.


Richard A. Huettner, Esq.
Kenyon & Kenyon Reilly Carr & Chapin
59 Maiden Lane
New York, New York 10038
(212) 425-7200
Attorney for Plaintiff-Appellant

NOTICE OF ENTRY

Sir:- Please take notice that the within is a (certified)
true copy of a
duly entered in the office of the clerk of the within
named court on 19

Dated,

Yours, etc.,

Attorney for
Office and Post Office Address

To

Attorney(s) for

NOTICE OF SETTLEMENT

Sir:- Please take notice that an order

of which the within is a true copy will be presented
for settlement to the Hon.

one of the judges of the within named Court, at

on the day of 19
at M.

Dated,

Yours, etc.,

Attorney for
Office and Post Office Address

To

Attorney(s) for

Index No. 74-1765

Year 1974

UNITED STATES COURT OF APPEALS
FOR THE SECOND CIRCUIT

ESSO RESEARCH & ENGINEERING
COMPANY,
Plaintiff-Appellant,

v.

KAHN AND COMPANY, INC. AND
CHANDLER-EVANS, INC.,
Defendants-Appellees.

CERTIFICATE OF SERVICE

Richard A. Huettnner, Esq.
Attorney for Plaintiff-Appellant
Office and Post Office Address, Telephone
59 Maiden Lane
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To

Attorney(s) for

Service of a copy of the within

is hereby admitted.

Dated,

Attorney(s) for

STATE OF NEW YORK, COUNTY OF

ss.:

The undersigned, an attorney admitted to practice in the courts of New York State,

Check Applicable Box
☐ Certification By Attorney
☐ Attorney's Affirmation

certifies that the within has been compared by the undersigned with the original and found to be a true and complete copy.

shows: deponent is

the attorney(s) of record for in the within action; deponent has read the foregoing and knows the contents thereof; the same is

true to deponent's own knowledge, except as to the matters therein stated to be alleged on information and belief, and that as to those matters deponent believes it to be true. This verification is made by deponent and not by

The grounds of deponent's belief as to all matters not stated upon deponent's knowledge are as follows:

The undersigned affirms that the foregoing statements are true, under the penalties of perjury.

Dated:

The name signed must be printed beneath

STATE OF NEW YORK, COUNTY OF

ss.:

Check Applicable Box
☐ Individual Verification
☐ Corporate Verification

the the foregoing deponent's own knowledge, except as to the matters therein stated to be alleged on information and belief, and as to those matters deponent believes it to be true.

being duly sworn, deposes and says: deponent is in the within action; deponent has read and knows the contents thereof; the same is true to

the of a corporation, foregoing is true to deponent's own knowledge, except as to the matters therein stated to be alleged upon information and belief, and as to those matters deponent believes it to be true. This verification is made by deponent because

in the within action; deponent has read the and knows the contents thereof; and the same is a corporation and deponent is an officer thereof.

The grounds of deponent's belief as to all matters not stated upon deponent's knowledge are as follows:

Sworn to before me on

19

The name signed must be printed beneath

STATE OF NEW YORK, COUNTY OF

ss.:

is over 18 years of age and resides at

Check Applicable Box
☐ Affidavit of Service By Mail
☐ Affidavit of Personal Service

On 19 deponent served the within attorney(s) for upon in this action, at

the address designated by said attorney(s) for that purpose by depositing a true copy of same enclosed in a post-paid properly addressed wrapper, in a post office — official depository under the exclusive care and custody of the United States Postal Service within the State of New York

On 19 at upon deponent served the within

herein, by delivering a true copy thereof to h personally. Deponent knew the person so served to be the person mentioned and described in said papers as the therein

Sworn to before me on

19

The name signed must be printed beneath